REGISTER

OF

LEHIGH UNIVERSITY

1911-1912

SOUTH BETHLEHEM
PENNSYLVANIA

1911

JULY.

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SEPTEMBER.

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OCTOBER.

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1912

JANUARY.

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MARCH.

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MAY.

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AUGUST.

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SEPTEMBER.

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OCTOBER.

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DECEMBER.

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1913

JANUARY.

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FEBRUARY.

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MARCH.

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APRIL.

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MAY.

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JUNE.

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CALENDAR.

1911.	1911–1912.
Sept. 15, 16, 18, 19, (Friday, Saturday, Monday, Tuesday)	Examinations for Admission.
Sept. 20, 3.30 P.M., (Wednesday)	First Term begins.
Oct. 7, (Saturday)	Founder's Day.
Nov. 29, 12.00 M., (Wednesday)	Thanksgiving Recess begins.
Dec. 4, 7.45 A. M., (Monday)	Thanksgiving Recess ends.
Dec. 22, 12.00 M., (Friday)	Christmas Holidays begin.
1912.	
Jan. 2, 7.45 A.M. (Tuesday)	Christmas Holidays end.
Jan. 26, 8.00 A. M., (Friday)	Examinations begin.
Feb. 2, 5.00 P. M., (Friday)	Examinations end.
Feb. 6, 7.45 A. M., (Tuesday)	Second Term begins.
Feb. 22, (Thursday)	Washington's Birthday Celebration.
April 3, 12.00 M., (Wednesday)	Easter Holidays begin.
April 9, 7.45 A. M., (Tuesday)	Easter Holidays end.
April 25, 5.00 P.M., (Thursday)	Short Intermission begins.
April 29, 7.45 A.M., (Monday)	Short Intermission ends.
May 27, 8.00 A. M., (Monday)	Senior Examinations begin.
May 30, (Thursday)	Memorial Day (half holiday).
May 30, 8.00 A.M., (Thursday)	Other Examinations begin.
June 6, 5.00 P. M., (Thursday)	Examinations end.
June 8, (Saturday)	Alumni Day.
June 9, (Sunday)	Baccalaureate Sunday.
June 10, (Monday).	Class Day.
June 11, (Tuesday)	University Day.
June 12, (Wednesday)	Summer Term begins.
June 12, 13, 14, 15, (Wednesday, Thursday, Friday, Saturday)	Examinations for Admission.
1912.	**1912–1913.**
Sept. 13, 14, 16, 17, (Friday, Saturday, Monday, Tuesday)	Examinations for Admission.
Sept. 18, 3.30 P.M., (Wednesday)	First Term begins.
Oct. 5, (Saturday)	Founder's Day.
Nov. 27, 12.00 M., (Wednesday)	Thanksgiving Recess begins.
Dec. 2, 7.45 A. M., (Monday)	Thanksgiving Recess ends.
Dec. 20, 12.00 M., (Friday)	Christmas Holidays begin.
1913.	
Jan. 2, 7.45 A. M., (Thursday)	Christmas Holidays end.
Jan. 24, 8.00 A. M., (Friday)	Examinations begin.
Jan. 31, 5.00 P. M., (Friday)	Examinations end.
Feb. 4, 7.45 A.M., (Tuesday)	Second Term begins.
Feb. 22, (Saturday)	Washington's Birthday Celebration.
March 19, 12.00 M., (Wednesday)	Easter Holidays begin.
March 25, 7.45 A. M., (Tuesday)	Easter Holidays end.
April 24, 5.00 P.M., (Thursday)	Short Intermission begins.
April 28, 7.45 A.M., (Monday)	Short Intermission ends.
May 26, 8.00 A. M., (Monday)	Senior Examinations begin.
May 29, 8.00 A. M., (Thursday)	Other Examinations begin.
May 30, (Friday)	Memorial Day (half holiday).
June 5, 5.00 P. M., (Thursday)	Examinations end.
June 7, (Saturday)	Alumni Day.
June 8, (Sunday)	Baccalaureate Sunday.
June 9, (Monday)	Class Day.
June 10, (Tuesday)	University Day.
June 11, (Wednesday)	Summer Term begins.
June 11, 12, 13, 14, (Wednesday, Thursday, Friday, Saturday)	Examinations for Admission.

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LEHIGH UNIVERSITY.

ORIGIN.

The Hon. Asa Packer, of Mauch Chunk, during the year 1865, appropriated the sum of $500,000, to which he added one hundred and fifteen acres of land in South Bethlehem, to establish an educational institution in the Lehigh Valley. On this foundation rose Lehigh University, incorporated by the Legislature of Pennsylvania by act approved February 9, 1866. In addition to these gifts, made during his lifetime, Judge Packer by his last will gave to the University and its Library an endowment of $2,000,000.

DESIGN.

The original object of Judge Packer was to afford the young men of the Lehigh Valley a complete education, technical, literary and scientific, for those professions represented in the development of the peculiar resources of the surrounding region. In furtherance of this purpose the University offers the following four-year courses:

1. The Courses in Arts and Science.
2. The Course in Civil Engineering.
3. The Course in Mechanical Engineering.
4. The Course in Metallurgical Engineering.
5. The Course in Electrometallurgy.
6. The Course in Mining Engineering.
7. The Course in Electrical Engineering.
8. The Course in Chemistry.
9. The Course in Chemical Engineering.

These courses are described in detail on pages 28 to 72.

REQUIREMENTS FOR ADMISSION.

Candidates for admission to Lehigh University must be at least sixteen years of age, must present a testimonial of good moral character, and must be qualified in the entrance subjects as enumerated below.

THE COURSES IN ARTS AND SCIENCE.

Candidates for admission to these Courses must present entrance requirements as follows:*

A. FOR THE COURSE LEADING TO THE DEGREE OF BACHELOR OF ARTS.

		Units.
English,		3
Latin,		4
Greek,	3	3
or { German A or French A,	2	
or { Elective,	1	
Ancient History,		1
History (Modern, English, or American),		1
Elementary Algebra,		1½
Plane Geometry,		1
		14½

Students who offer German, or French, and an Elective for admission, but, having had no opportunity to prepare in Greek, desire to take up that study in the University, are at present permitted to substitute beginners' Greek for the regular Greek of the Freshman year. They then pursue the study of Greek throughout the course.

*A "unit" is the equivalent of at least five exercises a week for one school year. Detailed information concerning these subjects may be found on pages 17 to 24.

B. FOR THE COURSES LEADING TO THE DEGREE OF BACHELOR OF SCIENCE.

1. All candidates must present the following subjects:

	Units.
English,	3
German A or French A,	2
History (Modern, English, or American),	1
Elementary Algebra,	1½
Plane Geometry,	1
	8½

2. Candidates must present besides the subjects in 1, 5½ units from the following:

	Units.
Advanced Algebra,	½
Solid Geometry,	½
Plane Trigonometry and Logarithms,	½
Latin,	2
French A or German A or Spanish A,	2
Ancient History,	1
Modern History,	1
English History,	1
Freehand Drawing,	½
Mechanical Drawing,	½
Physics,	1
Elementary Chemistry,	1
Zoölogy,	½ or 1
Botany,	½ or 1
Physiology and Hygiene,	½ or 1
Physiography,	½ or 1
Manual Training,	½ or 1

Details regarding these requirements are given on pages 17 to 24.

Graduates of High Schools who are unable to present German or French as specified under 1, but who can offer four units in Latin, in keeping with the official curriculum of the High Schools of the State, may substitute the two additional units of Latin for French or German.

THE COURSES IN TECHNOLOGY.

1. Candidates for admission to the Courses in Civil Engineering, Mechanical Engineering, Metallurgical Engineering, Electrometallurgy, Mining Engineering, Electrical Engineering, Chemistry, and Chemical Engineering must present the following subjects:

	Units.
English,	3
German A or French A,	2
History (Modern, English, or American),	1
Elementary Algebra,	1½
Advanced Algebra,	½
Plane Geometry,	1
Solid Geometry,	½
Plane Trigonometry and Logarithms,	½
	10

2. Candidates must present besides the subjects in 1, 4 units from the following:

	Units.
Latin,	2 or 3
Greek,	2 or 3
German,	2 or 3
French,	2 or 3
Spanish,	2 or 3
Ancient History,	1
Modern History,	1
English History,	1
Freehand Drawing,	½
Mechanical Drawing,	½
Physics,	1
Elementary Chemistry,	1
Zoölogy,	½ or 1
Botany,	½ or 1
Physiology and Hygiene,	½ or 1
Physiography,	½ or 1
Manual Training,	½ or 1

*A "unit" is the equivalent of at least five exercises a week for one school year. Detailed information concerning these subjects may be found on pages 17 to 24.

The detailed requirements in the various subjects are as follows:

ENGLISH.

Preparation in English has two main objects: (a) command of correct and clear English, spoken and written; (b) ability to read with accuracy, intelligence and appreciation.

ENGLISH GRAMMAR AND COMPOSITION. The first object requires instruction in grammar and composition. English grammar should ordinarily be reviewed in the secondary school; and correct spelling and grammatical accuracy should be rigorously exacted in connection with all written work during the four years. The principles of English composition governing punctuation, the use of words, paragraphs, and the different kinds of composition, including letter writing, should be thoroughly mastered; and practice in composition, oral as well as written, should extend throughout the secondary school period. Written exercises may well comprise narration, description, and easy exposition and argument based upon the principles of elementary rhetoric, as given in any approved High School Rhetoric. It is advisable that subjects for this work be taken from the student's personal experience, general knowledge, and studies other than English, as well as from his reading in literature. Finally, special instruction in language and composition should be accompanied be concerted effort of teachers in all branches to cultivate in the student the habit of using good English in his recitations and various exercises, whether oral or written.

LITERATURE. The second object is sought by means of two lists of books, headed respectively *reading* and *study;* from which may be framed a progressive course in literature covering four years. In connection with both lists, the student should be trained in reading aloud and be encouraged to commit to memory some of the more notable passages both in verse and in prose. As an aid to literary appreciation, he is further advised to acquaint himself with the most important facts in the lives of the authors whose works he reads and with their place in literary history.

The books for reading and study are to be selected from the groups suggested by the Conference on Uniform Entrance Requirements in English. 3 units.

HISTORY.

The requirement in History is based on the recommendation of the Committee of Seven of the American Historical Association.

ANCIENT HISTORY, with special reference to Greek and Roman History, and including also a short introductory study of the more ancient nations and the chief events of the early Middle Ages, down to the death of Charlemagne (814). 1 unit.

MEDIAEVAL AND MODERN EUROPEAN HISTORY, from the death of Charlemagne to the present time. 1 unit.

ENGLISH HISTORY. With due reference to social and political development. 1 unit.

AMERICAN HISTORY AND CIVIL GOVERNMENT. With due reference to social and political development. 1 unit.

The examinations in history will be so framed as to require comparison and the use of judgment on the pupil's part rather than the mere use of memory. The examinations will presuppose the use of good text-books, collateral reading, and practice in written work. Geographical knowledge will be tested by requiring the location of places and movements on an outline map.

MATHEMATICS.

ELEMENTARY ALGEBRA, ALGEBRA TO QUADRATICS. The four fundamental operations for rational algebraic expressions. Factoring, determination of highest common factor and lowest common multiple by factoring. Fractions, including complex fractions, and ratio and proportion. Linear equations, both numerical and literal, containing one or more unknown quantities. Problems depending on linear equations. Radicals, including the extraction of the square root of polynomials and of numbers. Exponents, including the fractional and negative. 1 unit.

ELEMENTARY ALGEBRA, QUADRATICS AND BEYOND. Quadratic equations, both numerical and literal. Simple cases of equations with one or more unknown quantities, that can be solved by the methods of linear or quadratic equations. Problems depending on quadratic equations. The binomial theorem for positive integral exponents. The formulas for the nth term and the sum of the terms of arithmetic and geometric progressions, with applications. ½ unit.

ADVANCED ALGEBRA. Binomial Theorem for any exponent, Logarithms, Compound Interest and Annuities, Theory of Quadratic Equations, Undetermined Co-efficients, Partial Fractions, and Series: Development, Tests for Convergence and Divergence, and Summation. ½ unit.

PLANE GEOMETRY. The usual theorems and constructions of good text-books, including the general properties of plane rectilinear figures; the circle and the measurement of angles; similar polygons; areas; regular polygons and the measurement of the circle. The solution of numerous original exercises, including loci problems. Applications to the mensuration of lines and plane surfaces. 1 unit.

SOLID GEOMETRY. The usual theorems and constructions of good text-books, including the relations of planes and lines in space; the properties and measurement of prisms, pyramids, cylinders, and cones; the sphere and the spherical triangle. The solution of numerous original exercises, including loci problems. Applications to the mensuration of surfaces and solids. ½ unit.

PLANE TRIGONOMETRY. Definitions and relations of the six trigonometric functions as ratios; circular measurement of angles. Proofs of principal formulas, in particular for the sine, cosine, and tangent of the sum and the difference of two angles, of the double angle and the half angle, the product expressions for the sum or the difference of two sines or of two cosines, etc.; the transformation of trigonometric expressions by means of these formulas. Solution of trigonometric equations of a simple character. Theory and use of logarithms (without the introduction of work involving infinite series). The solution of right and oblique triangles and practical applications. Candidates must bring their logarithmic tables to the examination. ½ unit.

Candidates must have a knowledge of the metric system and be prepared to solve problems in either Algebra or Geometry involving the use of the metric system.

PHYSICS.

The Course of Instruction in Physics should include:

(a) The study of some standard text-book, for the purpose of obtaining a connected view of the subject. (b) Instruction by lecture table demonstrations, to be used mainly for illustration of the facts and phenomena of physics. (c) Individual laboratory work consisting of at least thirty experiments.

The aim of laboratory work should be to supplement the pupil's fund of concrete knowledge and to cultivate his power of accurate observation and clearness of thought and expression. The exercises should be chosen with a view to furnishing forceful illus-

trations of fundamental principles and their practical applications. They should be such as yield results capable of ready interpretation, obviously in conformity with theory, and free from the disguise of unintelligible units. 1 unit.

MODERN LANGUAGES.

ELEMENTARY GERMAN, A. This requirement follows, in the main, the recommendations of the Committee of Twelve of the Modern Language Association. It is expected that two whole years will be given to the work.

During the first year the work should comprise:

1. Careful drill upon pronunciation.

2. The memorizing and frequent repetition of easy colloquial sentences.

3. Drill upon the rudiments of grammar; that is, upon the inflection of the articles, of such nouns as belong to the language of every-day life, of adjectives, pronouns, weak verbs, and the more usual strong verbs; also upon the use of the more common prepositions, the simpler uses of the modal auxiliaries, and the elementary rules of syntax and word-order.

4. Abundant easy exercises designated not only to fix in mind the forms and principles of grammar, but also to cultivate readiness in the reproduction of natural forms of expression.

5. Reading of from 75 to 100 pages of graduated texts from a reader, with constant practice in translating into German easy variations upon sentences selected from the reading lesson (the teacher giving the English), and in the reproduction from memory of sentences previously read.

During the second year the work should comprise:

1. The reading of from 150 to 200 pages of literature in the form of easy stories and plays.

2. Accompanying practice, as before, in the translation into German of easy variations upon the matter read and also in the offhand reproduction, sometimes orally and sometimes in writing, of the substance of short and easy selected passages.

3. Continued drill upon the rudiments of the grammar, directed to the ends of enabling the pupil, first, to use his knowledge with facility in the formation of sentences, and secondly, to state his knowledge correctly in the technical language of grammar.

2 units.

INTERMEDIATE GERMAN, B. This work should comprise, in addition to the elementary course, the reading of about 400 pages of moderately difficult prose and poetry, with constant practice in giving, sometimes orally and sometimes in writing, paraphrases, abstracts, or reproductions from memory of selected portions of the matter read; also grammatical drill upon the less usual strong verbs, the use of articles, cases, auxiliaries of all kinds, tenses and modes (with special reference to the infinitive and the subjunctive), and likewise upon word order and word formation.

1 unit.

ELEMENTARY FRENCH, A. This requirement follows, in the main, the recommendations of the Committee of Twelve of the Modern Language Association. It is expected that two whole years will be given to the work.

During the first year the work should comprise:

1. Careful drill in pronunciation.
2. The rudiments of grammar, including the inflection of the regular and the more common irregular verbs, the plural nouns, the inflection of adjectives, participles, and pronouns; the use of personal pronouns, common adverbs, prepositions, and conjunctions; the order of words in the sentence, and the elementary rules of syntax.
3. Abundant easy exercises, designed not only to fix in the memory the forms and principles of grammar, but also to cultivate readiness in the reproduction of natural forms of expression.
4. The reading of from 100 to 175 pages of graduated texts, with constant practice in translating into French easy variations of the sentences read (the teacher giving the English), and in reproducing from memory sentences previously read.
5. Writing French from dictation.

During the second year the work should comprise:

1. The reading of from 250 to 400 pages of easy modern prose in the form of stories, plays, or historical or biographical sketches.
2. Constant practice, as in the previous year, in translating into French easy variations upon the texts read.
3. Frequent abstracts, sometimes oral and sometimes written, of portions of the text already read.
4. Writing French from dictation.
5. Continued drill upon the rudiments of grammar, with constant application in the construction of sentences.

6. Mastery of the forms and uses of pronouns, pronomial adjectives, of all but the rare irregular verb forms, and of the simpler uses of the conditional and subjunctive. 2 units.

INTERMEDIATE FRENCH, B. This should comprise the reading of from 400 to 600 pages of French of ordinary difficulty, a portion to be in the dramatic form; constant practice in giving French paraphrases, abstracts or reproductions from memory of selected portions of the matter read; the study of a grammar of moderate completeness; writing from dictation. 1 unit.

ELEMENTARY SPANISH, A. The completion of some elementary Spanish Grammar together with the reading of not less than 300 pages of simple Spanish prose. 2 units.

INTERMEDIATE SPANISH, B. The reading of not less than 500 additional pages of Spanish prose together with the translation of at least 40 pages of simple connected English prose into Spanish. 1 unit.

LATIN.

The following requirements in Latin are in accordance with the recommendations made by the Commission on College Entrance Requirements in Latin, October, 1909.

LATIN, A & B. Required of applicants for admission to the B.A. Course; elective for others. First and Second Year Latin. Grammar, Elementary Prose Composition. Reading of an amount not less than Caesar, Gallic War, I-IV, selected by the schools from Caesar (Gallic War and Civil War) and Nepos (Lives). 2 units.

LATIN, C. Required of applicants for admission to the B.A. Course; elective for others. Third Year Latin. Reading of an amount not less than Cicero, Orations against Cataline, For the Manilian Law, and For Archias, selected by the schools from Cicero (Orations, Letters, and De Senectute) and Sallust (Catiline and Jugurthine War). 1 unit.

LATIN, D. Required of applicants for admission to the B.A. Course. Fourth Year Latin. Reading of an amount not less than Vergil, Aeneid I-VI, selected by the schools from Vergil (Aeneid, Bucolics, and Georgics) and Ovid (Metamorphoses, Fasti, Tristia, Amores). 1 unit.

Candidates for admission who offer Latin as an elective entrance subject, must present at least two units.

GREEK.

The following requirements in Greek are selected in as close accordance as is practicable with the recommendations of the American Philological Association.

GREEK. Grammar; Elementary Prose Composition, consisting principally of detached sentences to test the candidate's knowledge of grammatical constructions; Xenophon: the first four books of the Anabasis; the translation, at sight, of a passage from some work of Xenophon. 2 units.

GREEK. Homer's Iliad, I-III: The first three books of the Iliad (omitting II, 494-end), and the Homeric forms, constructions, and prosody. 1 unit.

Candidates for admission who offer Greek as an elective entrance subject, must present at least two units.

CHEMISTRY.

The requirement in Chemistry is based on the report of the Committee on Chemistry of the Science Department of the National Educational Association.

ELEMENTARY CHEMISTRY. It is recommended that the candidate's preparation in chemistry should include: (a) Individual laboratory work, comprising at least forty exercises. (b) Instruction by lecture-table demonstrations, to be used mainly as a basis for questioning upon the general principles involved in the pupil's laboratory investigations. (c) The study of at least one standard text-book, to the end that the pupil may gain a comprehensive and connected view of the most important facts and laws of elementary chemistry.

Students, properly qualified, will be examined in Elementary Chemistry on the first Saturday of the term; those passing the examination will take Theoretical Chemistry during the first term.

DRAWING.

FREEHAND DRAWING. Sketching of simple geometrical figures, of objects, and from copy. At least twenty plates must be submitted. ½ unit.

MECHANICAL DRAWING. The use of instruments and the preparation of at least twenty plates, illustrating the elements of descriptive geometry or simple machine parts. ½ unit.

PHYSIOGRAPHY.

The study of one of the leading secondary text-books in physical geography, that a knowledge may be gained of the essential principles, and of well-selected facts illustrating those principles.

Individual laboratory work, comprising at least forty exercises with notebook, is recommended. ½ or 1 unit.

BOTANY.

An amount equal to that contained in Bergen's "Foundations of Botany" with laboratory work. ½ or 1 unit.

PHYSIOLOGY AND HYGIENE.

A course covering, approximately, what is given in such a textbook as Huxley & Youman's "Physiology and Hygiene."
½ or 1 unit.

ZOÖLOGY.

The equivalent of Jordan, Kellogg & Heath's "Animal Studies" with laboratory work. ½ or 1 unit.

MANUAL TRAINING.

MANUAL TRAINING. Shop work in wood or metal in schools giving courses in manual training. ½ or 1 unit.

DATE OF EXAMINATIONS.

Examinations for admission to the University will be held in 1912, on Wednesday, Thursday, Friday, and Saturday, June 12, 13, 14, and 15, and on Friday, Saturday, Monday, and Tuesday, September 13, 14, 16, and 17. In 1913, on June 11, 12, 13, and 14, and September 12, 13, 15, and 16.

The examinations are held in June and September in the following order:

First Day.—Geometry, 8 A.M.; Physics and Latin, 2 P.M.

Second Day.—Elementary Algebra, 8 A.M.; Advanced Algebra, 2 P.M.

Third Day.—Trigonometry, 8 A.M.; German, French and Greek, 2 P.M.

Fourth Day.—English, 8 A.M.; History, 2 P.M.

Examinations in subjects presented for "elective" units may be arranged by correspondence with the Registrar.

Candidates for admission wishing to obtain credit for any subject of the first term of the Freshman year should notify the Registrar before September 1.

Certificates of the College Entrance Examination Board are accepted in lieu of the entrance examinations held at the University in those subjects in which the recorded grade is C (60 per cent.) or over.

DIVISION OF EXAMINATIONS FOR ADMISSION.

Candidates for admission to the Freshman Class may pass all the examinations in June, or all in September, or some in June and the rest in September of the year of entrance, or may take them in *two consecutive years.* In the last case, for all courses candidates may present themselves for examination in the first year in the following subjects: Plane Geometry, English, and History. In addition, candidates for the B.A. course in Arts and Science may present themselves for examination in the first year in Latin Grammar, Caesar, Cicero; and one of the following: (*a*) Greek Grammar and three books of Anabasis; (*b*) German; (*c*) French.

Candidates intending to enter the University in September are advised to present themselves for examination in June; if they are not fully prepared at that time they will receive credit for the examinations then satisfactorily passed.

ADMISSION TO ADVANCED STANDING.

Candidates for admission to advanced studies in any course are required to pass, *in addition to the entrance examinations for that course*, examinations in the work already done by the classes which they desire to enter. These examinations are held in September on the same days as those for entrance to the Freshman Class. The additional subjects may be found in the schedule of studies of the different departments.

A student from another college or university is admitted without entrance examinations, provided he has covered the entrance subjects required at this University and has attended another college or university for one or more complete terms. Evidence to that effect should first be filed with the Registrar. If a student has been dropped from another college or university, he must present his record to the Committee on Standing of Students and his admission will largely depend upon the record he made in the institution from which he was dropped.

Applicants who have obtained a certificate that the entrance requirements of the University are satisfied and who desire to enter the University are advised to report personally to the Secretary of the Faculty. The Secretary of the Faculty will issue to the applicant a paper authorizing him to confer with the professors regarding the subjects already taken by the class that he de-

sires to enter. It is necessary for an applicant to bring a certificate naming the subjects completed at another college, together with a copy of the catalogue or register of the college; and it is desirable for him to bring his drawings, field notes, computations and laboratory note books for inspection, and personal certificates from his teachers showing the grades attained at the college from which he comes. In case it is inconvenient for the applicant to report in person, he may send the credentials here mentioned by mail or express to the Secretary of the Faculty, who will place them before the professors and communicate the result to the applicant. Professors may admit the student to advanced standing if satisfied with these evidences of proficiency, or they may find it necessary to give a formal examination in the subjects for which he desires credits.

Professors will note their conclusions on the paper furnished the applicant, who must return the same to the Secretary of the Faculty within the time specified on its face. If all the subjects are accepted the applicant will be admitted in full standing to the Freshman, Sophomore, or Junior Class, as the case may be. If nearly all are accepted, the candidate may be admitted with conditions, and the Secretary of the Faculty will inform him of the rules applicable to conditioned students.

Graduates of other colleges having the Bachelor's degree or its equivalent are similarly admitted to advanced standing. The length of time necessary for the completion of a course will depend entirely upon the student's attainments at entrance and his ability. Every opportunity will be given for the completion of a course in the minimum time possible.

It is desirable that a student who anticipates taking a technical course at Lehigh University after graduating from college should so arrange his work in college as to cover as many as possible of the subjects of the Freshman and Sophomore years of the technical course he intends to enter.

ADMISSION TO GRADUATE COURSES.

Students of this University who have taken their first degree, and others, on presenting a diploma of an equivalent degree conferred elsewhere, are admitted to advanced studies, according to the plan to be found on page 114 under the general subject of Graduate Courses.

PREPARATORY SCHOOL CERTIFICATES.

The University has no permanent arrangement with any preparatory school whereby certificates are accepted in lieu of entrance examinations.

Those who desire to enter on certificate must request their preparatory school principals to send to the Registrar as soon as the school closes in June a complete record of their preparatory school work. Blanks for this purpose will be furnished by the University.

The certificate will be submitted to the professors in charge of the entrance subjects and if the work has been pursued and completed in a manner and within a time limit satisfactory to the professors concerned the certificate will be accepted in the subjects which it covers.

EXAMINATIONS AT SCHOOLS.

When desired by the Principals, arrangements will be made to hold at the schools the June examinations for admission to the University. Such requests should be made before June 1.

COURSES IN ARTS AND SCIENCE.

A. COURSE LEADING TO THE DEGREE OF BACHELOR OF ARTS.

This course is planned to meet the requirements of a liberal education, and to lay the foundation for the study of the several professions and for the intelligent following of business and industrial pursuits. The University desires that the work of this course be not merely academic in character, but of practical worth, and that it sustain a direct relation to the needs of the life and profession which each student has in view. The studies are to a great extent elective, but in order that the culture purpose which is the basis of the plan of study may not be ignored, a limited amount of work in subjects of a literary, philosophic, and scientific character, which are both accepted instruments of culture and necessary preliminaries of all higher study, is required of each student. The required work includes courses in the English, German, French, Latin, and Greek languages and literatures, in mathematics, physics, chemistry, economics, psychology, and philosophy. Beyond this the work is elective. During the Freshman year the studies are prescribed; from then on they become increasingly subject to the student's own choice.

In pursuance of the policy of making this course practical and directly preparatory to each student's life-work, large freedom is allowed in the choice of electives. Any study which is taught in the University may be taken, subject to the qualification and purpose of the student. Students are counseled to select their work systematically with reference to some definite end. In this they receive the assistance and coöperation of the Faculty, under the oversight of one of whose members each student arranges his course. Endeavor is made to treat students individually rather than in groups, and to suit the work of each to his needs and qualifications. Instruction is given by lectures, by recitations, by the assignment of readings and topics for special study and dissertations, and when the subject admits of it, by practical work in field or laboratory. Field work or laboratory work accompanies

courses in surveying, geology, physics, chemistry, astronomy, biology, psychology, and allied subjects; and the classes of the evening school conducted by the Department of Education give opportunity for practice in teaching.

ADMISSION, LENGTH OF COURSE, DEGREE.

The requirements for admission are stated in detail on page 14. Students who enter on Greek must continue the study of Greek throughout the Freshman year; and those who, having had no opportunity to prepare in Greek, desire to begin the study of Greek in college (see page 14) will begin it in the Freshman year and pursue it ordinarily throughout the course.

The course of study extends over four years. Students, however, who can do so, are permited to pass off required work in advance and to fill up the time thus left free with other advanced studies, with a view to completing the requirements for graduation in a shorter time.

The degree of Bachelor of Arts is bestowed upon graduates of this course in Arts and Science.

PREPARATION FOR LAW, MEDICINE, TEACHING, ETC.

Young men who have in view the professions of law, medicine, theology, teaching, or journalism, will find in the curriculum of the course in Arts and Science that general and special preliminary training which is more and more becoming essential. For the better preparation of such men for entrance upon their professional studies the University is constantly enlarging its curriculum as need determines. Laboratory work accompanies the courses in psychology, an evening school is conducted in which students of Education may practice teaching, and the fine equipment of Williams Hall furnishes superior facilities for the teaching of biology and zoölogy, and for practical courses in bacteriology. The opportunities which the biological, chemical and physical laboratories of the University afford for preliminary medical studies, and for preparation to teach these sciences are unsurpassed.

COMBINATION OF LITERARY AND TECHNICAL STUDIES.

The desirability of a liberal training for an engineer has led the University to offer courses in which, by combining the studies of the several technical departments with the work of the course in Arts and Science, a student may gain both a literary and a professional education, with the corresponding degrees, in six years. These courses possess decided advantages over the usual

engineering curriculum of four years, the studies of which are necessarily almost wholly technical, and the value of the wider training for which they provide far outweighs the extra expenditure of time. The outline in full of a combined course leading to the degrees of B.A. and C.E. is printed on pages 42 and 43.

TABULAR EXHIBITION OF STUDIES.

The following tables of studies exhibit the required and the elective studies of this course, together with the number of hours assigned to each in the several terms and years.

SCHEDULE OF REQUIRED STUDIES AND HOURS.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Latin, (3)	40	Latin, (5)	41, 42
English, (3)	120, 121, 125	English, (2)	122, 125
Solid Geometry, (3)	140	Trigonometry, (3)	141, 142
Greek, (4)	50	Greek, (4)	51
or Chemistry, (4)	390, 391	*or* { Qual. Analysis, (3)	393
German, (3)	90 *or* 96	Stoichiometry, (1) }	394
or French, (3)	74	German, (3)	91 *or* 97
Gymnasium, (2)	440	*or* French, (3)	75
		Gymnasium, (2)	440

The course in Greek is for students who have entered on Greek, that in French for those who have entered on French. Course 96 in German is for those who have entered on German, course 90 for those who have entered on Greek or French, who, however, may take course 96 if qualified.

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
English, (2)	123, 126	English, (2)	124, 126
French, (3)	70 *or* 76	French, (3)	71 *or* 77
Chemistry, (4)	390, 391	German, (3)	97 *or* 98
or Quant. Anal., (4)	397, 398		
or Chem. Philos., (3)	395		
German, (3)	96 *or* 98		

A minimum of six hours of work in the first term, and nine hours in the second term is to be added to the above, chosen from the Sophomore Elective Studies on page 31.

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Psychology, (2)	1	Psychology, (2)	2
Economics, (2)	16	Economics, (2)	17
*Physics, (4)	324		
English, (1)	127		

*Omitted by students who have elected Physics in the Sophomore year.
The figures in parentheses indicate the number of exercises per week.

A minimum of nine hours (or thirteen hours in the case of those who omit the course in Physics,) in the first term, and thirteen hours in the second term is to be added to the above, chosen from the Junior Elective Studies on page 32.

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
History of Philosophy, (2)	7	History of Philosophy, (2)	8
		Thesis, (3)	

A minimum of fifteen hours in the first term and twelve hours in the second term is to be added to the above, chosen from the Senior Electives on page 32.

ELECTIVE STUDIES.

From the following list of elective studies have been excluded in general those studies which, peculiarly technical or professional, enter into the combined academic and engineering courses. See page 29.

Many of the subjects are not restricted to the years to which they are assigned, but may be taken subsequently. But this privilege is limited by considerations of the roster, and the principle that the course of each student shall be systematic, and not haphazard.

Students are required to submit their electives to the Professor in charge of electives, for the first term on or before May 1, for the second term on or before December 15, in order that they may be incorporated in the general roster of the University.

SOPHOMORE ELECTIVES.

FIRST TERM.		SECOND TERM.	
Latin, (3)	43	Latin, (3)	44
Greek, (3)	52	Greek, (3)	53
Advanced Algebra, (3)	143	Differential Calculus, (4)	145
Analytic Geometry, (4)	144	Elementary Mechanics, (5)	321
Elementary Mechanics, (2)	320	{ Qualitative Anal., (3)	393
Quantitative Anal., (4)	397,398	} Stoichiometry, (1)	394
or Chem. Philos., (3)	395	Quantitative Analysis, (4)	399
		Advanced Chemistry, (3)	403
		*Physiography, (3)	277

*The course in Physiography is prerequisite to the course in History in the Junior year.

JUNIOR ELECTIVES.

FIRST TERM.		SECOND TERM.	
Latin, (3)	45 *or* 47	Latin, (3)	46 *or* 48
Greek, (3)	54 *or* 56	Greek, (3)	55 *or* 57
Anglo-Saxon, (3)	129	English Philology, (3)	130
French, (3)	70 *or* 76	French, (3)	75 *or* 77
German, (3)	96, 98 *or* 100	German, (3)	98 *or* 100
Italian, (3)	115	Italian, (3)	116
Spanish, (3)	111	Spanish, (3)	111
History, (3)	35	History, (3)	34 *or* 36
Education, (2) *or* (3),	10	Education, (2) *or* (3)	11
Integral Calculus, (4)	145	Scientific Method, (2)	9
Physics, (4)	322	Astronomy, (3)	148
Quantitative Anal., (4)	397,398	Analytic Mechanics, (2)	147
Chemical Philosophy, (3)	395	Physics, (4)	323
Mineralogy, (4)	267	Quantitative Analysis, (4)	399
Biology, (3)	292	Advanced Chemistry, (3)	403
		Geology, (3) *or* (4)	270
		Comparative Anatomy, (3)	293
		Botany, (2)	290

SENIOR ELECTIVES.

FIRST TERM.		SECOND TERM.	
Latin, (3)	45 *or* 47	Latin, (3)	46 *or* 48
Greek, (3)	54 *or* 56	Greek, (3)	55, 57, *or* 58
English, (3)	131	English, (3)	132 *or* 133
French, (3)	78 *or* 79	French, (3)	77, 78, *or* 79
German, (3)	101, 102 *or* 103	German, (3)	101, 102, *or* 104
Italian, (3)	115	Italian, (3)	116
Spanish, (3)	112	Spanish, (3)	112
Economics, (2)	18 *or* 20	Economics, (2)	19 *or* 21
Public Law, (2)	22 *or* 24	Public Law, (2)	23 *or* 25
Psychology, (2), (3), *or* (4)	3, 5, 6	Psychology, (2), (3), *or* (4)	3, 5, 6
Education, (2) *or* (3)	12	Education, (2) *or* (3)	12
Practical Astronomy, (3)	149	Theory of Heat, (4)	329
Theory of Light, (5)	329	Electrical Engineering, (2)	362
Elec. and Magnetism, (2)	325	Electrical Laboratory, (1)	327
Electrical Laboratory, (1)	326	Dynamo Laboratory, (1)	356
Dynamos and Motors, (2)	354	Alternating Currents, (2)	357
Dynamo Laboratory, (1)	355	Sanitary Chemistry, (3)	416
Quantitative Analysis, (4)	408	Organic Chemistry, (4)	409
Physical Chem., (4)	417, 418	Org. Chem. Lab., (2) *or* (3)	410
Petrography, (2)	279	Petrography, (1)	280
Embryology, (2)	294	Econ. Geol., (2), *or* (3)	272 *or* 274
Bacteriology, (2)	296	Sanitary Biology, (2)	295

B. COURSES LEADING TO THE DEGREE OF BACHELOR OF SCIENCE.

Four plans of study leading to the degree of Bachelor of Science are offered by the University in the Department of Arts and Science. These are:

1. A course in which the Biological and Chemical sciences predominate.

2. A course in which the Geological sciences predominate.

3. A course in which Mathematical and Physical sciences predominate.

4. A course in Business Administration.

These courses are based upon entrance requirements which embrace a large variety of subjects commonly taught in the High Schools of the State, without, however, enforcing upon applicants for admission the necessity of the higher mathematics required for admission to the engineering courses of the University, or the amount of Latin required for admission to the course leading to the degree of Bachelor of Arts.

To give these courses purpose and coherence they are planned along definite lines, having in view proficiency in some special branch of science but with such an admixture of literary, economic, and philosophic studies as may give them breadth and save them from becoming distinctly professional courses. The work, therefore, included in the several plans of study is largely fixed. In the choice of electives and in the general conduct of his work, a student is under the direction of the head of the department in which the main content of his course lies.

These courses are designed to meet the needs of several classes of men: of those who are preparing for the study of medicine, for which a college training in Biology, Chemistry and allied subjects, as well as in liberal studies, is almost essential; of those who are preparing for the study of law, for whom a college course in history, economics, and sociology is equally valuable; of men who will find employment in the Geological Survey work of the Government, or as exploratory or economic geologists in connection with mining organizations; of those who are contemplating a business career, or the management of industrial and financial enterprises; of those who will use these courses, in

whole or in part, as the basis of a broader technical training; and of men who are preparing to become teachers. There is a distinct need for well-trained teachers of sciences in the secondary schools of the State, and the scientific spirit and equipment of this University peculiarly qualify it for the work. (See further the Courses for Teachers, page 40.)

The course in Business Administration is to prepare young men for the commercial and administrative sides of our leading business organizations. It is intended for those who have no inclination for the engineering courses but who are desirous of obtaining a knowledge of the fundamentals of mining, metal, and transportation industries. This knowledge combined with that derived from a study of economics, finance, accounting, and business law makes a significant appeal to those looking forward to business careers in private life or as public officials.

These Courses are open to any students who present the entrance requirements for the B.S. courses in the Department of Arts and Science. For the students presenting the entrance requirements for the B.A. course special arrangements will be made to enable them to take the work.

Following is an outline of the plans of study of these several courses. For the first three of these courses the work of the Freshman year is the same. After that they begin to differentiate.

The work of these courses covers four years and on its completion the degree of B.S. is awarded.

SCHEDULES OF STUDIES OF THE B.S. COURSES.

FRESHMAN YEAR.

In the Biological, Geological, and Mathematical courses the studies of the Freshman Year are the same.

FIRST TERM.		SECOND TERM.	
English, (3)	120, 121, 125	English, (2)	122, 125
German, (3)	96	German, (3)	97
or French, (3)	74	*or* French, (3)	75
Solid Geometry, (3)	140	Trigonometry, (3)	141, 142
Chemistry, (2)	390	Qualitative Analysis, (3)	393
Chemical Laboratory, (2)	391	Stoichiometry, (1)	394
Elementary Mechanics, (2)	320	Elementary Mechanics, (5)	321
Freehand Drawing, (1)	155	Gymnasium, (2)	440
Science and Scientists, (1)	15		
Gymnasium, (2)	440		

I. COURSE IN WHICH BIOLOGY AND CHEMISTRY PREDOMINATE.

FRESHMAN YEAR. (See page 34.)

SOPHOMORE YEAR.

FIRST TERM.

Quantitative Analysis, (5)	396
Quant. Anal. Conf., (1)	398
Chemical Philosophy, (3)	395
English, (2)	123, 126
German, (3)	98 *or* 90
Physics, (4)	322

SECOND TERM.

Advanced Chemistry, (3)	403
English, (2)	124, 126
German, (3)	98 *or* 91
Physics, (4)	323
Geology, (4)	270
Scientific Method, (2)	9

JUNIOR YEAR.

FIRST TERM (*Required*).

Biology, (3)	292
English, (1)	127
German, (3)	100 *or* 96
or French, (3)	70
Psychology, (2)	1
Economics, (2)	16

Electives (7 hours).

Physical Chemistry, (3)	417
Physical Chem. Lab., (1)	418
German, (3)	101
French, (3)	76
History, (3)	35
Mineralogy, (4)	267

SECOND TERM (*Required*).

Botany, (2)	290
Comparative Anatomy, (3)	293
German, (3)	100 *or* 97
or French, (3)	71
Psychology, (2)	2
Economics, (2)	17

Elective (6 hours.)

Organic Chemistry, (4)	409
Organic Chem. Lab., (3)	410
German, (3)	101
French, (3)	77
History, (3)	34 *or* 36
Physiography, (2) *or* (3)	277

SENIOR YEAR.

FIRST TERM (*Required*).

Embryology, (2)	294
Bacteriology, (2)	296
History of Philosophy, (2)	7
Education, (2) *or* (3)	11

Electives (9 hours).

Forestry, (3)	291
English, (3)	131
German, (3)	102
French, (3)	78
Economics, (2)	18
Business Law, (2)	20
Public Law, (2)	22
Public Law, (2)	24
Applied Paleontology, (2)	275
Petrography, (2)	279

SECOND TERM (*Required*).

Sanitary Chemistry, (3)	416
History of Philosophy, (2)	8
Education, (2) *or* (3)	11
Thesis in Biology, (3)	

Electives (9 hours).

English, (3)	132
German, (3)	102
French, (3)	78
Economics, (2)	19
Business Law, (2)	21
Public Law, (2)	23
Public Law, (2)	25
Geology of N. America, (3)	276
Blowpipe Analysis, (1)	269

2. COURSE IN WHICH THE GEOLOGICAL SCIENCES PREDOMINATE.

FRESHMAN YEAR. (See page 34.)

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Mineralogy, (5)	268	Geology, (5)	271
Blowpipe Analysis, (1)	259	Blowpipe Analysis, (1)	269
English, (2)	123, 126	English, (2)	124, 126
German, (3)	100 *or* 96	German, (3)	100 *or* 97
Quantitative Analysis, (3)	397	Advanced Chemistry, (3)	403
Quant. Anal. Conf., (1)	398	Physics, (4)	323
Physics, (4)	322		

JUNIOR YEAR.

FIRST TERM (*Req.*).		SECOND TERM (*Req.*).	
Petrography, (2)	279	Petrography, (1)	280
English, (1)	127	Physiography, (2)	277
German, (3)	100 *or* 96	Economic Geology, (2)	272
or French, (3)	70	German, (3)	100 *or* 97
Psychology, (2)	1	*or* French, (3)	71
Economics, (2)	16	Psychology, (2)	2
Biology, (3)	292	Economics, (2)	17
Electives (5 hours).		Botany, (2)	290
German, (3) *or* French, (3)		*Electives (4 hours).*	
or Spanish, (2)	101, 76, *or* 110	German, (3) *or* French, (3)	
Chemical Philosophy, (3)	395	*or* Spanish, (2)	101, 77, *or* 110
Physical Chem., (4)	417, 418	Metallurgy, (3)	248-250
Assaying, (3)	412	Education, (2) *or* (3)	11
Scientific Method, (2)	9	History, (3)	34 *or* 36
Education, (2) *or* (3)	10	Sanitary Biology, (2)	295
Forestry, (3)	291	Comparative Anatomy, (3)	293
Advanced Algebra, (3)	143	Differential Calculus, (4)	145
Analytic Geometry, (4)	144	Land Surveying, (4)	163
Mechanical Drawing, (2)	312	Mining Eng., (5)	302-306
Mining Eng., (3)	300-302	Construction, (2)	169

SENIOR YEAR.

FIRST TERM (*Req.*).		SECOND TERM (*Req.*).	
Field Geology, (2)	278	Economic Geology, (3)	274
Applied Paleontology, (2)	275	Geology of N. America, (3)	276
Mining and Geol. Law, (1)	283	History of Philosophy, (2)	8
History of Philosophy, (2)	7	Thesis in Geology, (3)	
Electives (10 hours).		*Electives (6 hours).*	
English, (3)	131	English, (3)	132
French, (3) *or* German, (3)		French, (3) *or* German, (3)	
or Spanish, (2)	78, 102, *or* 110	*or* Spanish, (2)	78, 102, *or* 110
Metallurgy, (4)	251	Education, (2) *or* (3)	12
Education, (2) *or* (3)	12	History, (3)	34 *or* 36
History, (3)	35	Business Law, (2) *or* (1)	21
Business Law, (2) *or* (1)	20	Public Law, (2)	25
Public Law, (2)	24	Economics, (2)	19
Economics, (2)	18	Comparative Anatomy, (3)	293
Embryology, (2)	294	Sanitary Biology, (2)	295
Bacteriology, (2)	296	Land Surveying, (4)	163
Ore Dressing, (3)	309, 310	Mine Administration, (1)	308
Mining Eng., (2)	307	Drawing and Design, (4)	313
Integral Calculus, (4)	145	Astronomy, (3)	148

3. COURSE IN WHICH PHYSICS AND MATHEMATICS PREDOMINATE.

FRESHMAN YEAR. (See page 34.)

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
English, (2)	123, 126	English, (2)	124, 126
German, (3)	98 *or* 90	German, (3)	98 *or* 91
Physics, (4)	322	Physics, (4)	323
Advanced Algebra, (3)	143	Differential Calculus, (4)	145
Analytic Geometry, (4)	144	Advanced Chemistry, (3)	403
Chemical Philosophy, (3)	395	Scientific Method, (2)	9

JUNIOR YEAR.

FIRST TERM (*Req.*).		SECOND TERM (*Req.*).	
Elec. and Magnetism, (2)	325	Differential Equations, (1)	146
Electrical Laboratory, (1)	326	Analytic Mechanics, (2)	147
Integral Calculus, (4)	145	German, (3)	100 *or* 97
German, (3)	100 *or* 96	*or* French, (3)	71
or French, (3)	70	Psychology, (2)	2
Psychology, (2)	1	Economics, (2)	17
Economics, (2)	16	*Electives* (*8 hours*).	
Electives (*4 hours*).		German, (3)	101
English, (1)	127	*or* French, (3)	77
German, (3)	101	*or* Spanish, (2)	110
or French, (3)	76	Astronomy, (3)	148
or Spanish, (2)	110	Electrical Laboratory, (1)	327
Education, (2) *or* (3)	10	Education, (2) *or* (3)	11
Physical Chem., (4)	417, 418	History, (3)	34 *or* 36
Quant. Analysis, (4)	397, 398	Physiography, (3)	277
Dynamos and Motors, (2)	354	Theory of Alt. Cur., (2)	357
Strength of Materials, (4)	172	Quant. Anal., (4)	399, 402
Mechanical Drawing, (2)	312		

SENIOR YEAR.

FIRST TERM (*Req.*).		SECOND TERM (*Req.*).	
History of Philosophy, (2)	7	History of Philosophy, (2)	8
Thermodynamics, (5)	216	Electric Waves, (2)	334
or Strength of Mat., (4)	172	*or* Vector Analysis, (2)	150
Electives (*10 or 11 hours*).		Thesis in Physics or Mathematics, (3)	
English, (3)	131	*Electives* (*10 hours*).	
German, (3)	102	English, (3)	132
or French, (3)	78 *or* 79	German, (3)	102
or Spanish, (2)	110	*or* French, (3)	78 *or* 79
Electrical Laboratory, (1)	328	*or* Spanish, (2)	110
Education, (2) *or* (3)	12	Electrical Laboratory, (1)	327
History, (3)	35	Education, (2) *or* (3)	12
Public Law, (2)	24	History, (3)	36
Business Law, (2)	20	Public Law, (2)	25
Biology, (3)	292	Business Law, (2)	21
Mineralogy, (4)	267	Comparative Anatomy, (3)	293
Dynamo Laboratory, (1)	355	Geology, (4)	270
Practical Astronomy, (3)	149		

4. COURSE IN BUSINESS ADMINISTRATION.

Business in these days is essentially a new occupation and requires a preliminary training more extensive and thorough than was formerly necessary. Successful men who entered upon their careers thirty, forty, or fifty years ago can hardly realize this, for they laid the foundations of their success before the present highly specialized industrial and commercial period. Formerly it was common for a lad to enter an office or financial institution and work his way to some directive position, but this becomes relatively less possible. Positions of responsibility require intelligence, with accurate and rapid thought-powers that education alone can give.

The Course in Business Administration has in view the making of business a "career;" and regards banking, foreign trade, and allied pursuits in the light of a liberal profession. The Course stands in the same relation to the life and calling of the manufacturer, the merchant, and other men of business as do the law and medical schools of the universities to lawyers and physicians. It provides a scientific training in the structure and organization of modern industry and commerce, and in the general causes and criteria of prosperity.

The work of the Course covers four years and on its completion the degree of B.S. is conferred.

4. COURSE IN BUSINESS ADMINISTRATION.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
History of Commerce, (2)	37	History of Commerce, (2)	37
English, (3)	120, 121, 125	English, (2)	122, 125
German, (3)	96	German, (3)	97
or French, (3)	74	*or* French, (3)	75
Solid Geometry, (3)	140	Trigonometry, (3)	141, 142
Chemistry, (2)	390	Qualitative Analysis, (3)	393
Chemical Laboratory, (2)	391	Stoichiometry, (1)	394
Freehand Drawing, (1)	155	Mechanical Drawing, (2)	312
Science and Scientists, (1)	15	Gymnasium, (2)	440
Gymnasium, (2)	440		

SOPHOMORE YEAR.

FIRST TERM.

Industrial History, (2)	38
Accounting, (3)	26
English, (2)	123, 126
German, (3)	98 *or* 90
French, (3)	70
or Spanish, (3)	111
CommercialGeography,(2)	33
Physiography, (3)	281

SECOND TERM.

Industrial History, (2)	38
Accounting, (3)	26
English, (2)	124, 126
German, (3)	98 *or* 91
French, (3)	71
or Spanish, (3)	111
Physiography of U. S., (3)	282
Geology, (3)	270

JUNIOR YEAR.

FIRST TERM (*Required*).

Accounting, (2)	27
Economics, (2)	16
German, (3)	99 *or* 96
French, (3)	74
or Spanish, (3)	112

Electives (8 hours).

History, (3)	35
English, (1)	127
Metallurgy, (3)	248-250
Physics, (4)	324
Psychology, (2)	1
Education, (2) *or* (3)	10
Biology, (3)	292
Forestry, (3)	291
Construction, (2)	168

SECOND TERM (*Required*).

Accounting, (2)	27
Economics, (2)	17
Public Finance, (3)	19
German, (3)	99 *or* 97
French, (3)	75
or Spanish, (3)	112

Electives (5 hours).

History, (3)	34
Industrial Chemistry, (3)	413
Psychology, (2)	2
Education, (2) *or* (3)	11
Comparative Anatomy, (3)	293
Economic Geology, (2)	272

SENIOR YEAR.

FIRST TERM (*Required*).

Business Law, (2)	20
Public Law, (2)	22
German, (3)	100 *or* 99
French, (3)	76
or Spanish, (3)	111

Electives (7 hours).

International Law, (2)	24
Labor Legislation, (2)	29
R. R. Administration, (2)	28
Metallurgy, (4)	251
Scientific Method, (2)	9
History of Philosophy, (2)	7
Education, (2) *or* (3)	12
Bacteriology, (2)	296
Mining and Geol. Law, (1)	283

SECOND TERM (*Required*).

Business Law, (2)	21
Public Law, (2)	23
German, (3)	100 *or* 99
French, (3)	77
or Spanish, (3)	112
Thesis in Economics or Law, (3)	

Electives (4 hours).

Theories of Govt., (2)	30
Theories of Society, (2)	31
Insurance, (2)	32
Mine Administration, (1)	308
English, (3)	132
History of Philosophy, (2)	8
Education, (2) *or* (3)	12
Geology of N. America, (3)	276
Economic Geology, (3)	274

C. COURSES FOR TEACHERS.

For some years past Lehigh University has been able partly to meet the demands made upon her for teachers by recommending men who have received here special training for the teacher's profession. More emphasis is being laid each year by school superintendents and principals upon the need for such training before men leave college. A knowledge of the theory of teaching is required for a license to teach in the public schools. It is our special aim to associate all instruction in the theory of education with the actual work to be done in the school room. This aim is promoted by our evening practice school, which provides to every student who desires it an opportunity to practice teaching under supervision. Visits also are made in connection with each course to neighboring schools, both public and private, and the work observed is carefully criticised and discussed.

The courses offered by the department of Philosophy and Education that are commonly recognized as especially helpful to the teacher, include the required courses in Psychology and the History of Philosophy, and also the History of Education, Educational Theory and Practice, Scientific Method, additional elective courses in Psychology, and the practice teaching. In these courses a total of twenty-three term hours may be taken in the Sophomore, Junior and Senior years. Thus it will be seen that Lehigh offers more pedagogical training than is demanded for a provisional college graduate certificate according to the new school code. Besides the required subjects it is recommended that each student who intends to teach take the courses in general biology and in sanitary biology. In arranging his curriculum the man who intends to teach should also have in mind early in his college career the importance of specializing in one line, and of being thoroughly competent in one or two related lines. The courses outlined on the preceding pages offer ample opportunity for the selection of subjects on this plan. The graduate is at a disadvantage who, when he begins his career as a teacher, either has no specialty, on the one hand, or is incompetent in anything but his specialty, on the other. Few young men realize how rapidly the profession of teaching is moving toward higher standards of efficiency and of remuneration. In Pennsylvania, the outlook is particularly favorable for men of character and intelligence.

D. COMBINED ACADEMIC AND ENGINEERING COURSES.

The University has long recognized the advantage of a broader education for an engineer than is possible within the limitations of the commonly accepted entrance requirements for an engineering course, and an engineering curriculum of four years, which of necessity is largely occupied by subjects of a technical and professional nature. The number of college graduates who choose engineering as a profession is increasing from year to year; and inasmuch as many of the subjects, *e.g.*, higher mathematics, physics, chemistry, which are essential to an engineering course, belong properly also in a college curriculum, college graduates usually fulfill the requirements for an engineering degree in from two to three years: the length of time depends largely upon the choice and character of the work of the college course. But a college graduate who subsequently proceeds to engineering study often finds that his training in subjects common to the two courses is inadequate to the successful application of them to engineering work. Time can be saved, a better correlation of work secured, when both courses are under one common guidance.

The University is able, by systematically combining the study of its several engineering schools with the studies peculiar to its courses in Arts and Science, to offer courses of six years' duration which lead to the degree of Bachelor of Arts or Bachelor of Science and an engineering degree, and in which neither the purpose nor the efficiency of either course is sacrificed. Students in these courses receive the Bachelor's degree at the end of four years, and the engineering degree upon the completion of the engineering studies.

Men of exceptional ability and diligence whose course in the preparatory school has been in advance of the Freshman entrance requirements for the B.A. or B.S. courses may complete the combined academic and engineering course in five years.

Following is the schedule of studies of a six years' course leading to the degrees of Bachelor of Arts and Civil Engineer. Combined courses leading to other engineering degrees, and likewise in combination with the Bachelor of Science courses, are also provided.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Latin, (3)	40	Latin, (5)	41, 42
English, (3)	120, 121, 125	English, (2)	122, 125
Solid Geometry, (3)	140	Trigonometry, (3)	141, 142
Greek, (4)	50	Greek, (4)	51
or Chemistry, (4)	390, 391	*or* Qual. Analysis, (3)	393
German, (3)	90 *or* 94	*or* Stoichiometry, (1)	394
or French, (3)	74	German, (3)	91 *or* 95
Gymnasium, (2)	440	*or* French, (3)	75
		Gymnasium, (2)	440

Students who have entered on Greek will take Greek, those who have entered on French will take French in the Freshman year. Course 94 in German is for students who have entered on German, course 90 for those who have entered on Greek or French, who, however, may take course 94 if qualified.

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
English, (2)	123, 126	English, (2)	124, 126
French, (3)	70 *or* 76	French, (3)	71 *or* 77
German, (3)	98	German, (3)	98
Advanced Algebra, (3)	143	Differential Calculus, (4)	145
Analytic Geometry, (4)	144	Elementary Mechanics, (5)	321
Elementary Mechanics, (2)	320		

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Psychology, (2)	1	Psychology, (2)	2
Economics, (2)	16	Economics, (2)	17
English, (1)	128	Physics, (4)	323
Chemistry, (4)	390, 391	Analytic Mechanics, (2)	147
or Quant. Anal., (4)	397, 398	Descriptive Geometry, (3)	161
Physics, (4)	322		
Integral Calculus, (4)	145		
Mechanical Drawing, (2)	160		

A minimum of four hours in the second term is to be added to the above, chosen by each student according to his qualifications from the Junior elective studies on page 32.

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
History of Philosophy, (2)	7	History of Philosophy, (2)	8
Mineralogy, (4)	267	Geology, (4)	270
Stereotomy, (3)	162	Land Surveying, (4)	163
Construction, (2)	168	Construction, (2)	169
		Thesis for B.A., (3)	

A minimum of six hours in the first term, and two hours in the second term is to be added to the above, chosen by each student according to his qualifications from the Senior elective studies on page 32.

SUMMER TERM.

Engineering Inspection, 184.

FIFTH YEAR.

FIRST TERM.		SECOND TERM.	
Strength of Materials, (4)	172	Hydraulics, (3)	177
Graphic Statics, (2)	174	Roofs and Bridges, (3)	176
Testing Laboratory, (1)	186	Hydraulic Laboratory, (1)	187
Roads and Pavements, (2)	175	Astronomy, (3)	148
Metallurgy, (3)	248-250	Railroad Surveying, (4)	165
Electrotechnology, (2)	372	Steam Engines, (3)	205
Dynamo Laboratory, (1)	355		

SUMMER TERM.

Topographic Surveying, 166.

SIXTH YEAR.

FIRST TERM.		SECOND TERM.	
Bridge Design, (6)	178	Bridges and Dams, (4)	180
Hydraulic Engineering, (4)	182	Sanitary Engineering, (3)	183
Railroads, (2)	170	Sanitary Biology, (2)	295
Steel Buildings, (2)	179	*or* Forestry, (2)	291
Geodetic Surveying, (3)	167	Railroads, (2)	171
or Prac. Astronomy, (3)	149	Cement and Concrete, (3)	181
		Thesis for C.E., (3)	188

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN CIVIL ENGINEERING.

The requirements for admission to this course may be found on page 16. While French will be accepted instead of German, it is recommended that the latter be offered, as its technical literature is of greater value to the civil engineer.

The purpose of this course is to give a broad education in those general and scientific subjects which form the foundation of all branches of technology, and special training in those subjects comprised under the term civil engineering. The aim of the department is to teach young men how to think, and how to attack new problems; to impress upon them the underlying principles of engineering and to inspire them with a desire to do their best work. The graduate is not only prepared to enter upon the location and construction work of railroads, bridges, water works, or sewerage plants, but can advantageously take up allied work in mining, mechanical, electrical, or architectural engineering.

During the Freshman year the time is mostly devoted to fundamental studies which give both general culture and preparation for the technical work of the following years. The study of Mathematics, Physics, English, and German is continued. Chemistry is taught partly by lectures and partly by practical manipulation in the laboratory. Drawing is done throughout the year, and, as is the case in practically all the courses in drawing presented by the Civil Engineering Department, the drawing room exercises are supplemented by recitations. There are lectures in Physiology and Hygiene, and systematic exercise in the gymnasium is required.

In the Sophomore year the fundamental subjects of Mathematics, Physics, and English are completed, and the technical work of civil engineering is begun by practical problems in Drawing and by lectures or recitations on Construction. The theory of Land Surveying is begun and is accompanied by field work and map drawing. Those who desire to take this subject in the vacation at the end of the Freshman year will be allowed to do so under the regulations stated on page 88.

The work in Topographic Surveying is done in the four weeks following the end of the Junior year. By this arrangement the attention of the student is concentrated upon a single subject, thus enabling practical field operations to be exemplified in the best possible manner. In Railroad Surveying both preliminary and final locations of a line are made, and plans, profiles, and estimates of cost are prepared. In Geodetic Surveying triangulations

of a high degree of precision are executed, as also determinations of azimuth, and adjustments of the results are made by the standard methods. A large collection of levels, transits, and other surveying instruments enables the student to become familiar with the instruments of the best manufacturers.

Under the head of Construction and of Cement and Concrete are grouped the topics of masonry, foundations, cements and mortars, walls, dams, arches, tunnels, and details of structures. The work covers three terms and is carried on by recitations and lectures using standard books and engineering journals. Visits of inspection to structures in the Lehigh Valley and vicinity are made, and written reports upon them are required. All the standard tests of cements and mortars are made by each student. In connection with the subject of Strength of Materials there is also work in the testing laboratory on timber, brick, iron, and steel.

The testing of materials is of great importance not only because of its effect on the student's understanding of the mechanics of engineering but because it gives him the ability to manipulate apparatus and to handle machines in a way that should prove useful in his future work.

Roofs and Bridges receive attention throughout four terms. The analysis of trusses by graphic methods is begun in the first term of the Junior year and later the analytical methods of computing stresses are taken up. Visits are made to bridges and sketches taken of details which are afterwards drawn to scale. Later, in the Senior year, designs and working drawings are prepared by each student for both highway and railroad bridges. Some of these drawings are made in the same manner as in the drawing room of a bridge company, while others are general, that is, design drawings only, and estimates of the final weight of the structure are prepared. The theory of cantilever, draw, suspension, and arched structures receives detailed attention, as also that of reinforced concrete structures. This extended training in bridge engineering furnishes a thorough foundation for successful work in practice.

Hydraulic and Sanitary Engineering are treated at length. The theory of the flow of water through orifices, weirs, pipes, and channels, together with the principles of hydraulic motors, is given in the Junior year, while in the Senior year the subjects of water supply and sewerage are discussed. The methods of collecting, purifying, and distributing water are explained and

compared; house drainage, the design of sewerage systems, and the disposal of sewage also receive attention. Computations for dams, standpipes, sewers and their appurtenances are made. Canal engineering, river and harbor work, and land drainage receive attention. Irrigation by both water and sewage is also discussed. This training in hydraulic and sanitary subjects, together with that in Construction, renders the graduate well qualified to enter upon the work of city engineering. In connection with the course in Hydraulic Engineering, measurements are made of the flow in the Lehigh River, the Lehigh Canal and other streams in the vicinity of South Bethlehem and the data thus obtained are studied later in the drawing room. In view of the increasing importance of water-power development this work is of great value and importance.

Among other required subjects may be noted that of Strength of Materials, which gives the theory of beams, columns, and shafts, and the methods of computing and designing them; as already noted, this subject is exemplified by practical work in the testing laboratory. The subject of Electrotechnology treats of the construction and operation of dynamos and motors. The subjects of Mineralogy and Metallurgy give excellent training in the observation of natural phenomena, and prepare the student for work in geology and allied subjects.

During the Senior year there are several elective subjects offered. In the first term the student may elect either Practical Astronomy or Geodetic Surveying; in the second term he may take Sanitary Biology or Forestry. Extra subjects may also be pursued, by permission of the Faculty, if the time of the student permits. In these subjects, as well as in all the work of this course, it is the aim to exemplify the theoretical principles by practical problems, inspections, designs and laboratory exercises. The testing laboratory of the University contains machines for making physical tests of tension, compression, flexure and torsion, and is of special value to students who prepare theses on investigations of the properties of materials.

For description of the Fritz Engineering Laboratory, which is operated by the Civil Engineering Department, see page 130.

The student who completes this course will receive the degree of Civil Engineer. Mature young men desiring to take special studies without being candidates for the degree will be afforded every facility in so doing. Graduates of this course may become candidates for the degree of Master of Science under the regulations stated on page 114.

THE COURSE IN CIVIL ENGINEERING.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Geometry, (4)	144	Differential Calculus, (4)	145
Chemistry, (2)	390	Elementary Mechanics, (5)	321
Chemical Laboratory, (2)	391	German, (3)	95
Elementary Mechanics, (2)	320	*or* French, (3)	75
German, (3)	94	Descriptive Geometry, (3)	161
or French, (3)	74	Spherical Trig., (1)	142
Mechanical Drawing, (2)	160	English, (2)	122, 125
English, (3)	120, 121, 125	Gymnasium, (2)	440
Gymnasium, (2)	440		

SUMMER TERM.

Land Surveying (optional), 163.

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Integral Calculus, (4)	145	Analytic Mechanics, (2)	147
Physics, (4)	322	Physics, (4)	323
Construction, (2)	168	Construction, (2)	169
Stereotomy, (3)	162	Land Surveying, (4)	163
Mineralogy, (4)	267	Geology, (4)	270
English, (2)	123, 126	English, (3)	124, 126, 128

SUMMER TERM.

Engineering Inspection, 184.

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Strength of Materials, (4)	172	Hydraulics, (3)	177
Graphic Statics, (2)	174	Roofs and Bridges, (3)	176
Testing Laboratory, (1)	186	Hydraulic Laboratory, (1)	187
Roads and Pavements, (2)	175	Astronomy, (3)	148
Metallurgy, (3)	248-250	Railroad Surveying, (4)	165
Electrotechnology, (2)	372	Steam Engines, (3)	205
Dynamo Laboratory, (1)	355	Economics, (1)	17
Economics, (2)	16		

SUMMER TERM.

Topographic Surveying, 166.

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Bridge Design, (6)	178	Bridges and Dams, (4)	180
Hydraulic Engineering, (4)	182	Sanitary Engineering, (3)	183
Railroads, (2)	170	Sanitary Biology, (2)	295
Steel Buildings, (2)	179	*or* Forestry, (2)	291
Geodetic Surveying, (3)	167	Railroads, (2)	171
or Prac. Astronomy, (3)	149	Cement and Concrete, (3)	181
		Thesis, (3)	185

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN MECHANICAL ENGINEERING.

The object of this course is the study of the Science of Machines. The principal subjects taught are: the nature, equivalence, and analysis of mechanisms, the mechanics or theory of the principal classes or types of machinery, mechanical technology, the principles and practice of machine design, and the measurements of power.

The earliest shop visits are for the purpose of acquainting beginners with machine parts and the usual tools of a shop. These visits are a part of the work of a summer term, lasting four weeks, which is held at the close of the second term of the Freshman year.

In the same summer term the students of Mechanical Engineering are also given a course in the examination of electrical instruments and machinery and in the inspection of their use and operation in electrical plants. This is regarded as a very desirable preliminary to the study of physics and to the special course in Electrical Engineering which is pursued later on.

A second summer term at the end of the Sophomore year provides a course of shop instruction (Mechanical Technology) which is principally devoted to familiarizing the students with those points in pattern-making, moulding, forging, fitting and finishing, that they need to know as designers of machinery.

The instruction in Machine Design begins in the first term of the Sophomore year and is continued throughout the year. There is a thorough drill in projection drawing. In this work freehand sketches are first made and measurements taken of machine pieces; these sketches are then converted into full-sized drawings. Then there is considerable practice in the interpretation of such drawings. This is followed by difficult projections and intersections and exercises in the empirical proportioning of machine parts. Both empirical and rational formulas are used to determine the dimensions of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods, the data being given as they would arise in practice and the drawings made full size. In the last year the Seniors undertake the calculations, estimates, and working drawings involved in the design of simple but complete machines, each student being engaged upon different machines. In the case of these machines and of the engine the general plan of arrangement is given to the students in the form of rough sketches, photographs

or wood cuts. In the last term the students are expected to make original designs for simple machinery, the object of which has been fully explained.

The students in Mechanical Engineering are given a special course in Electrical Engineering after they have finished the regular and general course in Physics. The object is to impart a clear conception of electrical units and a working knowledge of resistance, impedance, inductance, reactance, capacity, and the magnetism of iron, and the magnetic circuit as used in the construction of electrical machinery. Attention is then directed to the theory and calculation of direct current dynamos, to the study of variable and alternating current phenomena, and to the theory of the alternating current transformer. Practical problems are given in these subjects to show their application. The laboratory work which accompanies this special course involves tests of resistance, insulation, consumption of energy, and efficiency.

The course in Engineering Laboratory begins with the handling and calibration of the instruments and appliances belonging to the experimental side of mechanical engineering; the simpler tests and experiments, along various lines, are taken up next; and there is a gradual progress toward complex operations as the complete test of a power plant or pumping station, or a full thermodynamic test of the steam engine. The course is, at present, most fully developed in the field of steam engineering, where it embraces steam calorimetry, flow of steam, the testing of steam-traps and separators, and of injectors, small pumps, and the steam turbine; extensive practice with the indicator, engine tests of various sorts, and boiler testing.

Gas engineering, work with compressed air, tests of hot-air engines, of centrifugal pumps, and of various incidental appliances and apparatus, are given due place in the course. Time is also devoted to dynamometer work with experiments in friction and lubrication, and determination of the efficiency of machines.

The purpose of this course, kept in view in the equipment and arrangement of the laboratory, is to provide a system of well selected and graded experiments which will illustrate and impress principles, develop the skill and judgment of the student, and give a broad training in the idea, method, and detail of this sort of work.

Graduates in this course receive the degree of Mechanical Engineer (M.E.).

THE COURSE IN MECHANICAL ENGINEERING.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Geometry, (4)	144	Differential Calculus, (4)	145
Chemistry, (2)	390	Elementary Mechanics, (5)	321
Chemical Laboratory, (2)	391	Qualitative Analysis, (3)	393
Elementary Mechanics, (2)	320	Stoichiometry, (1)	394
German, (3)	94	German, (3)	95
or French, (3)	74	*or* French, (3)	75
Freehand Drawing, (1)	155	English, (2)	122, 125
English, (3)	120, 121, 125	Gymnasium, (2)	440
Gymnasium, (2)	440		

SUMMER TERM. Constructive Elements of Machinery and of Electrical Apparatus, 201, 350.

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Integral Calculus, (4)	145	Differential Equations, (1)	146
Physics, (4)	322	Analytic Mechanics, (2)	147
Elem. Mech. Materials, (1)	185	Physics, (4)	323
Drawing and Mach. Des., (3)	200	Steam Engine, (4)	204
Boilers, (1)	203	French, (3)	71
French, (3)	70	*or* German, (3)	91
or German, (3)	90	English, (2)	124, 126
English, (3)	123, 126, 128	Machine Design, (3)	202

SUMMER TERM. Mechanical Technology, 206.

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Mech. of Machinery, (2)	207	Mech. of Machinery, (3)	211
Graphic Statics, (2)	173	Hydraulics, (3)	177
Dynamos and Motors, (2)	354	Electrical Laboratory, (1)	327
Dynamo Laboratory, (1)	355	Engineering Lab., (1)	209
Elec. and Magnetism, (2)	325	Electrical Engineering, (2)	362
Electrical Laboratory, (1)	326	Dynamo Laboratory, (1)	356
Engineering Lab., (2)	208	Alternating Currents, (2)	357
Strength of Materials, (4)	172	Metallurgy, (3)	248-250
Economics, (1)	16	Economics, (1)	17
French, (2)	73	French, (2)	73
or German, (2)	92	*or* German, (2)	93

SUMMER TERM. Engineering Laboratory, 212.

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Thermodynamics, (5)	216	Machine Design, (5)	224
Kinematics of Mach., (4)	217	Engineering Lab., (1)	228
Machine Design, (5)	218	Mech. of Machinery, (4)	227
Engineering Lab., (1)	220	Steam Turbines, (5)	229
Gas Engines, (3)	230	Thesis, (3)	231
Business Law, (1)	20		

A special option in Electrical Engineering may be arranged.

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN METALLURGICAL ENGINEERING.

This course is designed to prepare the student for practice in the field of metallurgy. In addition to the general studies underlying all technical education, instruction is given in Freehand and Projection Drawing, the Strength of Materials, Testing Laboratory, Mechanical Technology, Steam Boilers, the Steam Engine, the Mechanics of Machinery, involving the study of hoisting and pumping engines, air compressors, blowing engines, fans, etc., and the graphic statics of mechanisms, the Measurement of Power, Hydraulics, including hydraulic motors, and Electrotechnology, including the theory of electric motors and dynamos and laboratory work in electrical measurements. The student is thus made acquainted with the principles involved in the design and construction of the buildings and machinery constituting a metallurgical plant and in the operation of the machines.

A thorough course is given in Physics, including laboratory work in mechanics and calorimetry.

In Chemistry, in addition to the training in chemical theory involved in the courses of Stoichiometry, Advanced Chemistry, and Chemical Philosophy, much time is devoted to work in the laboratory, involving the qualitative and quantitative analysis, both gravimetric and volumetric, of the more common ores and metallurgical products, including gas analysis and dry assaying. The student is thus made thoroughly familiar with the principles of the two chief sciences on which the operations of metallurgy are based and with the methods of analysis employed in the laboratories of smelting works.

Courses are given in Mineralogy and Blowpipe Analysis involving practice in the identification of crystals and of minerals by their physical properties and their behavior before the blowpipe. An elective course in Quantitative Blowpipe Analysis is open to a limited number of students.

A course in Petrology gives practice in the macroscopic examination of rocks and is followed by courses in Historic, Dynamic and Economic Geology, and by two terms' work in the microscopic examination of rocks and of metallurgical materials.

A course in Ore Dressing renders the student familiar with the principles and methods of the mechanical preparations of ores and fuels.

The special instruction in Metallurgy is begun by a course in Metallurgical Construction. The class is taken on visits of inspection to neighboring metallurgical works. Each student makes sketches and takes notes on an assigned portion of the plant. From these working drawings are made and reports written describing and discussing the plant inspected. The student is thus rendered familiar with the furnaces and apparatus employed in metallurgical establishments, and with the methods in use in their drafting rooms. Courses of lectures in Metallurgy extend throughout the year. In these the chief weight is laid upon the chemical and physical principles involved in the various metallurgical processes. In order to impress these principles upon the mind of the student and to render their application familiar he is required to solve a series of problems which embody them. The problems are chiefly such as confront the metallurgist in his practice. In the course of Metallurgical Design the class is required to design a metallurgical plant to be operated under given conditions, a certain portion being assigned to each student. This involves calculations of stresses, weights and costs, the execution of working drawings and the discussion of the methods and apparatus chosen.

The metallurgical laboratory affords opportunity for special investigations in subjects connected with Metallurgy to such advanced students as are competent to conduct them, while laboratory work is regularly given which includes practice in the use of calorimeters and pyrometers, and exercise in the methods of investigation and measurement which a metallurgist should know how to conduct. The newly equipped metallographic laboratory affords facilities for acquainting students with the newer developments of physical metallurgy.

The proximity of the works of the Bethlehem Steel Company and of the New Jersey Zinc Company, and the kindness of their officers, give opportunities for frequent visits of inspection by the students in classes and individually, and thus afford unusual facilities for the practical study of the metallurgy of iron and of zinc. In connection with the metallurgical laboratory, it is the practice to make extensive investigations of the working efficiencies of furnaces in actual operation. Occasional visits of inspection are made to more distant works, in connection with the metallurgy of copper, lead, gold and silver.

Graduates in this course receive the degree of Metallurgical Engineer (Met.E.).

THE COURSE IN METALLURGICAL ENGINEERING.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Geometry, (4)	144	Differential Calculus, (4)	145
Chemistry, (2)	390	Elementary Mechanics, (5)	321
Chemical Laboratory, (2)	391	German, (3)	95
German, (3)	94	*or* French, (3)	75
or French, (3)	74	Qualitative Analysis, (3)	393
Elementary Mechanics, (2)	320	Stoichiometry, (1)	394
English, (3)	120, 121, 125	English, (2)	122, 125
Freehand Drawing, (1)	155	Gymnasium, (2)	440
Mechanical Drawing, (2)	312		
Gymnasium, (2)	440		

SUMMER TERM.

Constructive Elements of Machinery and of Electrical Apparatus, 201, 350.

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Integral Calculus, (4)	145	Physics, (4)	323
Physics, (4)	322	Quantitative Analysis, (4)	399
Metallurgical Const., (3)	314	Advanced Chemistry, (3)	403
Quantitative Analysis, (3)	397	English, (3)	124, 126, 128
Chemical Philosophy, (3)	395	Drawing and Design, (4)	313
English, (2)	123, 126		

SUMMER TERM. Mechanical Technology, 206.

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Strength of Materials, (4)	172	General Metallurgy, (2)	245
Boilers, (1)	203	Metallurgy of Iron, (2)	246
Mineralogy, (5)	268	Metallurgical Probs., (1)	247
Blowpipe Analysis, (1)	259	Geology, (4)	270
Assaying, (3)	412	Economic Geology, (3)	274
Quantitative Analysis, (3)	408	Blowpipe Analysis, (1)	269
Economics, (1)	16	Steam Engine, (3)	205
		Economics, (1)	17

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Metallurgy, (4)	251	Mech. of Machinery, (4)	227
Metallurgical Probs., (1)	252	Hydraulics, (3)	177
Ore Dressing, (2)	309	Electrometallurgy, (1)	255
Ore Dressing Lab., (1)	310	Metallurgical Design, (2)	243
Electrotechnology, (2)	372	Metallurgical Lab., (1)	253
Mech. of Machinery, (2)	207	Engineering Lab., (1)	222
Petrography, (2)	279	Petrography, (1)	280
Engineering Lab., (1)	221	Thesis, (6)	261
Metallography, (2)	258		

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN ELECTROMETALLURGY.

This course is designed to prepare the student to enter the rapidly developing fields of electrometallurgy and electrochemistry.

For the first year the course is identical with that in Metallurgical Engineering, embracing fundamental instruction in mathematics, physics, drawing, and modern languages. In the last three years this course agrees with the Metallurgical Engineering course in the inclusion of Chemical Analysis, Chemical Philosophy, Mineralogy, Metallurgy, Ore Dressing, Boilers, Steam Engine, Measurement of Power and the general culture studies; it differs from it by devoting less time to assaying, by omitting certain courses in Civil and Mechanical Engineering, and by devoting the time thus gained to electrical and electrochemical subjects. The subjects thus introduced are Advanced Theory of Electricity and Magnetism, with practical work in measurement of current, resistance, electromotive force, inductive capacity, magnetic testing of iron, etc.; Theory of Direct and Alternating Current Dynamos and Motors, with experimental studies and tests, Electrical Generating Stations, Transmission and Receiving Systems; Theory of Electrochemistry and Principles of Electrometallurgical and Electrochemical Practice, with experimental studies and tests in the laboratory.

In the course in Electrochemistry particular attention is paid to the quantitative side of the subject, such as resistance of electrolytes, the energy requirements of the electrolytic cell, the applications of Faraday's laws to solutions and fused electrolytes, the influence of current density, concentration, diffusion and temperature on the nature of the products of electrolysis, the theory as developed in the lectures being illustrated in practice by each student in the well-equipped electrochemical laboratory. Similarly, in Electrometallurgy the descriptions of the processes of extracting metals as given in the lecture room are illustrated by the student himself in the laboratory by complete measurements of energy requirements, current efficiencies, etc., of electrometallurgical methods. Towards the end of the term an electrometallurgical subject is given each student, to be investigated practically by him in the laboratory.

Graduates in this course receive the degree of Electrometallurgist (El.Met.).

THE COURSE IN ELECTROMETALLURGY.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Geometry, (4)	144	Differential Calculus, (4)	145
Chemistry, (2)	390	Elementary Mechanics, (5)	321
Chemical Laboratory, (2)	391	German, (3)	95
German, (3)	94	*or* French, (3)	75
or French, (3)	74	Qualitative Analysis, (3)	393
Elementary Mechanics, (2)	320	Stoichiometry, (1)	394
English, (3)	120, 121, 125	English, (2)	122, 125
Freehand Drawing, (1)	155	Gymnasium, (2)	440
Mechanical Drawing, (2)	312		
Gymnasium, (2)	440		

SUMMER TERM. Constructive Elements of Machinery and of Electrical Apparatus, 201, 350.

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Integral Calculus, (4)	145	Physics, (4)	323
Physics, (4)	322	Drawing and Design, (4)	313
Chemical Philosophy, (3)	395	Quantitative Analysis, (5)	399
Quantitative Anal., (4)	397, 398	Advanced Chemistry, (3)	403
Metallurgical Const., (3)	314	English, (3)	124, 126, 128
English, (2)	123, 126		

SUMMER TERM. Mechanical Technology, 206.

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Strength of Materials, (4)	172	General Metallurgy, (2)	245
Mineralogy, (5)	268	Metallurgy of Iron, (2)	246
Blowpipe Analysis, (1)	259	Metallurgical Probs., (1)	247
Elec. and Magnetism, (2)	325	Blowpipe Analysis, (1)	269
Electrical Laboratory, (1)	326	Alternating Currents, (2)	357
Dynamos and Motors, (2)	354	Electrical Engineering, (2)	362
Boilers, (1)	203	Hydraulics, (3)	177
Economics, (1)	16	Electrical Laboratory, (1)	327
		Dynamo Laboratory, (1)	355
		Steam Engine, (3)	205
		Economics, (1)	17

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Metallurgy, (4)	251	Electrometallurgy, (1)	255
Metallurgical Probs., (1)	252	Electromet. Design, (2)	244
Ore Dressing, (2)	309	Electromet. Lab., (1)	257
Ore Dressing Lab., (1)	310	Metallurgical Lab., (1)	253
Blowpipe Analysis, (1)	260	Engineering Lab., (1)	222
Engineering Lab., (1)	221	Electric Power, (3)	375
Electric Stations, (2)	370	Dynamo Laboratory, (2)	378
Dynamo Laboratory, (1)	356	Thesis, (6)	262
Electrical Laboratory, (1)	328		
Electrochemistry, (1)	254		
Electrochemical Lab., (2)	256		
Metallography, (2)	258		

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN MINING ENGINEERING.

The object of this course is to prepare the student for practice in the field of Mining Engineering. It is designed to give him not only the thorough training of an engineer, but also that broadness of education which enables him to readily undertake the great variety of propositions which naturally present themselves to one of his profession.

The course is therefore a very broad one, and when completed, it places him in the path of a great number of opportunities. Not only will he have had sufficient practice and training to enable him to enter upon the field of mining, but he can also readily take up work in chemistry, geology, metallurgy, electrometallurgy; and in chemical, civil, electrical, or mechanical engineering.

The principal objects in view, however, are that he may be enabled:—

First. To make surface and underground surveys, and to plot the same; also to map the topography and geology of a district.

Second. To analyze and treat substances encountered on a mining property, to value and report upon the same; and to analyze metallurgical products.

Third. To make mining, metallurgical or other designs to meet the requirements of given cases, and to enter upon the construction and take charge of the same.

Fourth. To take upon graduation a subordinate position as an engineer in connection with any of the previously mentioned lines of engineering.

In the Freshman year the time is practically devoted to laying a broad foundation in the fundamental subjects of English, Modern Languages, Mathematics and Physics, thus preparing the way for the technical and scientific studies of the following years. Lectures are given in Hygiene, and Gymnasium exercises under a competent director are required.

The course in Drawing begins, as soon as the student enters college, with freehand sketching of such subjects as bear upon future work. Parallel with the preceding is taught Mechanical Drawing, in which course he learns the use of drawing instruments, makes tracings and blue prints, solves problems in Descriptive Geometry, and in the Sophomore year makes drawings of machine parts of simple construction. In Metallurgical Construction he becomes familiar with metallurgical plants by frequent visits to those in the vicinity and by sketches and drawings of typical metallurgical furnaces and equipment elsewhere.

The Summer School in Constructive Elements of Machinery and of Electrical Apparatus gives the student the acquaintance with machine and electrical parts which is so necessary for every mining engineer. It is held at the close of the Freshman year, while the Summer Schools in Land and Topographic, Mine and Railroad Surveying, of four weeks each,—given at the close of the Sophomore and Junior years respectively,—enable the student to devote his entire time to each subject and the practical operations therein involved. The last of these three schools is conducted partly in the mining regions and not only gives him practice in mine and railroad surveying, but enables him to study mining operations and mining plants from which data is obtained exemplifying class room work as well as facilitating that in Mining Design.

The course in Chemistry extends from the first term of the Freshman year to the middle of the Junior year. It begins with an introduction to general chemical theory and the elements,—supplemented by laboratory work; the subject is continued by qualitative and quantitative analysis and assaying; chemical problems and reactions are taught under Stoichiometry. The instruction includes the analysis, by standard methods, of common ores, fuels, gases and metallurgical products.

Mineralogy is introduced by a short course in Crystallography in which the student studies accurately made models of crystals; carefully selected mineral specimens are then thoroughly studied and the various means of identification are applied to more difficult examples, the determination of which may be assisted and effected by Blowpipe Analysis.

Biology gives an excellent training in the study of animal life. The study of living organisms, their structure, development, origin and distribution, is taken up in this course.

The importance of conservation of the timber resources of the country and the preservation of woods against decay are treated in Forestry. Following a brief introduction to Botany, the characteristics of the woods of the important timber species are given particular attention.

In the courses in Geology he learns the forms and structures of the rock masses of the earth's crust, and the forces which modify them. A brief review of historical geology follows, dealing with the fossil life of the earth and its application to the determination of the age of strata. Practice in Field Geology teaches him the methods by which rock formations are accurately

mapped. Economic Geology treats of the formation of cavities in rocks and their relation to ore deposits, together with the manner in which minerals have been deposited:—the structure, geographical horizon and distribution of the principal non-metallic and metallic mineral deposits are then taken up. The course in Petrography in the Junior year enables the common rock-forming minerals to be readily identified by means of the microscope, especially when the constituents are too fine grained to be determined by the eye alone. The grouping of these minerals into rock textures is then taken up and by laboratory and field practice the student learns to recognize the main types of rock.

In Boilers and Steam and Gas Engines the common types and accessories are fully treated; work in the Engineering Laboratory enables complete tests to be made upon the same, and their efficiencies and powers under varying conditions are calculated.

A thorough course in Strength of Materials treats of the theory and practice which govern the elasticity and strength of all forms of common materials which are used in constructions. Methods of computing and designing beams, columns, shafts, etc., and practical work in the testing laboratory are prominent features of this course. Hydraulics treats of the flow of water through orifices, mains, pipes and channels, and also of the principles of hydraulic motors.

The course in Graphic Statics gives the student the ability to analyze the forces which exist in roof trusses, beams and girders by the graphical method, while that in Mechanics of Machinery enables him to apply the same method to the determination of the direction and magnitude of all the forces acting in a machine.

The instruction in Mining Engineering is given in a series of courses extending over the entire Junior and Senior years, under the following subdivisions: Prospecting, boring, mining, haulage and hoisting, drainage, ventilation, lighting and accidents treat successively of the steps by which minerals are discovered and valued, the manner in which they are extracted from the earth and brought to the surface, the means by which mines are maintained in an economical condition both from the standpoint of the mine owner and that of the miner, and finally the manner in which accidents may occur, the means for guarding against the same, and the treatment of injured persons. The subject of Ore Dressing, supplemented by work in the laboratory, treats of the processes by which ores or fuels, direct from the mine, are rendered marketable.

Mine and Railroad Construction and Mine Administration treat respectively of the materials used in roads and structures in and around mines, and of the methods of employing labor, keeping accounts, and of management.

In Metallurgy, the general principles of the subject, embracing fuels, furnaces, and processes, are thoroughly presented, followed by the metallurgy of iron and steel, copper, lead, silver, gold, zinc, mercury, and aluminum. Electrometallurgy familiarizes the student with the practical applications of electricity to metallurgical processes.

Electrotechnology, extending over the entire Senior year, embraces the study of the industrial applications of electricity which are of particular value to the mining engineer, and includes practical work in the Dynamo Laboratory.

In Mining and Metallurgical Design the student embodies the foregoing principles and makes designs and working drawings of plant to fulfill given conditions.

A course in Spanish for the benefit of those who purpose practicing their profession in Spanish-speaking countries, is offered as an extra study during the Senior year. It is a required study in the Geological Alternative.

The facilities for exemplifying the work of the course are almost unequalled. Numerous cement mills, cement, slate and other quarries, ore and coal mines, are within easy distance, while in the same town are the great works of the Bethlehem Steel Co. During the Junior and Senior years inspection trips, required of all students, are made to the anthracite regions and metal mining districts of eastern Pennsylvania and New Jersey, as well as to the metallurgical works of those districts.

For description of the Eckley B. Coxe Mining Laboratory, in which are contained the office and recitation rooms of the Department of Mining Engineering, as well as the ore dressing, assaying, chemical, and surveying equipment of the department, see page 131.

Each student is required to present a thesis on some topic bearing upon the work of the course, and while it is generally customary to select it from some subject connected directly with mining, geology, or metallurgy, it may be selected from subjects in other departments.

Graduates in this course receive the degree of Engineer of Mines (E.M.).

THE COURSE IN MINING ENGINEERING.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Geometry, (4)	144	Differential Calculus, (4)	145
Chemistry, (2)	390	Elementary Mechanics, (5)	321
Chemical Laboratory, (2)	391	Qualitative Analysis, (3)	393
Elementary Mechanics, (2)	320	Stoichiometry, (1)	394
German, (3)	94	German, (3)	95
or French, (3)	74	*or* French, (3)	75
Freehand Drawing, (1)	155	English, (3)	122, 125, 128
Mechanical Drawing, (2)	312	Gymnasium, (2)	440
English, (3)	120, 121, 125		
Gymnasium, (2)	440		

SUMMER TERM. Constructive Elements of Machinery and of Electrical Apparatus, 201, 350.

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Integral Calculus, (4)	145	Spherical Trig., (1)	142
Physics, (4)	322	Physics, (4)	323
Quantitative Analysis, (3)	397	Quantitative Analysis, (3)	399
Quant. Anal. Conf., (1)	398	Quant. Anal. Conf., (1)	402
Mineralogy, (5)	268	Geology, (5)	271
Blowpipe Analysis, (1)	259	Blowpipe Analysis, (1)	269
Drawing and Design, (2)	313	Drawing and Design, (4)	313

SUMMER TERM. Land and Topographic Surveying, 163, 166.

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Mining Eng., (3)	300-302	Mining Eng., (5)	302-306
Metallurgical Const., (3)	314	General Metallurgy, (2)	245
Assaying, (3)	412	Metallurgy of Iron, (2)	246
Boilers, (1)	203	Metallurgical Probs., (1)	247
Strength of Materials, (4)	172	Economic Geology, (2)	272
Petrography, (2)	279	Steam Engine, (3)	205
Forestry, (3)	291	Hydraulics, (3)	177
Economics, (1)	16	Economics, (1)	17

SUMMER TERM. Mine and Railroad Surveying, 311.

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Ore Dressing, (2)	309	Mining Design, (4)	315
Ore Dressing Lab., (1)	310	Mine Administration, (1)	308
Mining Eng., (2)	307	Metallurgical Design, (2)	243
Metallurgy, (4)	251	Electrometallurgy, (1)	255
Electrotechnology, (2)	372	Electrotechnology, (2)	379
Dynamo Laboratory, (1)	355	Dynamo Laboratory, (1)	356
Mech. of Machinery, (2)	207	Economic Geology, (3)	274
or Gas Engines, (2)	230	Engineering Lab., (1)	222
Graphic Statics, (2)	173	Thesis, (3)	316
Engineering Lab., (1)	221		
Field Geology, (2)	278		

The figures in parentheses indicate the number of exercises per week.

GEOLOGICAL ALTERNATIVE IN THE COURSE IN MINING ENGINEERING.

The object of this alternative is to meet the recent demand of certain branches of mining engineering for additional training in geology and allied subjects.

The work of the mining engineer has of late years become divided into two rather distinct lines of work; in the one the engineer is essentially a resident engineer and remains in one general locality; in the other work he is especially concerned with mine examinations, reports on mining properties, etc., and travels about, remaining in a single locality only sufficiently long to thoroughly understand the geological features and the facilities which a property offers for development.

The resident mining engineer is called upon to superintend the operations of ore extraction and treatment and to generally direct the actual mining. His work, while it requires a very thorough knowledge of geology in order that he may be capable of conducting the underground development of the property, is more especially concerned with the civil, mechanical, and electrical engineering features of the work, such as the construction of mine plant, tipples, head-frames, equipment for ore extraction, cheapest methods of mining, ore dressing, treatment, etc. This is especially true of engineers employed in coal regions or localities where geological features are either simple or so thoroughly worked out and described as to offer no problems of special difficulty.

On the other hand, to the mining engineer who is chiefly occupied in the valuation of prospective mining properties or is called upon to superintend or open up deposits in remote localities, geology becomes a subject of paramount importance. An additional training in the geological examination of ore deposits is absolutely essential. A thorough knowledge of all available sources of published information on all parts of the country, and a working knowledge of structural features, distribution of geologic formations and general geological features of the North American continent are necessary.

There has been in addition to this kind of work, an increasing demand for a class of mining engineers usually designated as mining geologists, who shall be especially occupied in the detailed working out of the geological features of mining properties. Such men are now frequently retained as resident engineers in

the employ of large mining companies, as well as by exploration companies in different parts of the world.

The geological alternative is designed to meet these several demands for the geological mining engineer. For the first two years the work in the courses is identical; in the Junior year the change is slight, being confined to an increase in Petrography and Physiography during the second term; in the Senior year the study of Applied Paleontology and that of the Geology of North America are substituted for certain subjects given in the regular course. By means of these particular studies the engineer is trained in the thorough knowledge and understanding of the geological structure, distribution of rocks, and physiographic features of North America. He becomes familiar with the literature of geology, prepares plates and maps illustrating the areas covered by all principal geological surveys, and is in possession of the latest information of a geological nature on any part of the American possessions to which he may be called.

These courses are designed to be as little divergent as possible in view of the requirements, so that the training in either one of the alternatives, while preparing a man more specifically for one branch of the work, will not prevent him from undertaking the other with success.

GEOLOGICAL ALTERNATIVE.

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Mining Eng., (3)	300-302	Mining Eng., (5)	302-306
Metallurgical Const., (3)	314	General Metallurgy, (2)	245
Assaying, (3)	412	Metallurgy of Iron, (2)	246
Strength of Materials, (4)	172	Metallurgical Probs., (1)	247
Petrography, (2)	279	Petrography, (1)	280
Biology, (3)	292	Hydraulics, (3)	177
Economics, (1)	16	Physiography, (2)	277
		Economic Geology, (2)	272
		Economics, (1)	17

SUMMER TERM. Mine and Railroad Surveying, 311.

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Ore Dressing, (2)	309	Mining Design, (2)	315
Ore Dressing Lab., (1)	310	Mine Administration, (1)	308
Mining Eng., (2)	307	Economic Geology, (3)	274
Metallurgy, (4)	251	Electrometallurgy, (1)	255
Electrotechnology, (2)	372	Electrotechnology, (2)	379
Dynamo Laboratory, (1)	355	Dynamo Laboratory, (1)	356
Graphic Statics, (2)	173	Geology of N. America, (3)	276
Field Geology, (2)	278	Spanish, (2)	110
Applied Paleontology, (2)	275	Thesis, (3)	316
Spanish, (2)	110		

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN ELECTRICAL ENGINEERING.

The object of this course is, first, to give a broad education in general and scientific subjects, and second, to give training in those special studies which are of most value in the equipment of the electrical engineer. The course includes a number of special studies in civil, mechanical and metallurgical engineering, and the graduate in Electrical Engineering is prepared, by the broad technical training which the course offers, not only to enter any of the branches of electrical engineering, but also to deal with the related problems in mechanical engineering, civil engineering and metallurgical engineering.

The fundamental studies in mathematics, physics, chemistry, and language, including English, are given in the early part of the course. These subjects include the more essential features of a broad education, and they furnish a preparation for the more advanced scientific and technical training to follow.

Electrotechnical work, begun early in the course during the summer term at the end of the Freshman year, is continued through the Sophomore year in the study of Electric Wiring, and Dynamos and Motors (with Dynamo Laboratory). The Junior and Senior years are devoted almost exclusively to advanced technical work. Two terms of Economics are required during the Junior year, followed by a short course in Business Law during the first term of the Senior year.

The study of Electricity and Magnetism during the first term of the Sophomore year constitutes an introduction to the industrial applications of electricity.

The subject of Electric Wiring, begun the first term of the Sophomore year, makes immediate application of electrical theory to the calculation of lighting and power circuits, the testing of insulation resistance, and similar problems. This study also includes the installation and wiring of electrical machinery, systems of electrical distribution, outside and interior wiring, and the rules for wiring prescribed by the Fire Insurance Companies.

The study of Dynamo Electric Machinery is begun the second term of the Sophomore year, and includes electrodynamics, the construction, operation, and control of direct current generators and motors, with numerous illustrative problems. This subject is continued during the first term of Junior year and is resumed during the first term of the Senior year under the name Alternating Current Machinery, which deals with alternators, single-

phase and polyphase motors, synchronous converters, transformers, and other apparatus.

The following special subjects in Mechanical Engineering are required in this course: Machine Design, begun in the first half of the Sophomore year, is continued for one year. Constructive Elements of Machinery is given in the summer term at the end of the Freshman year in conjunction with the work in Constructive Elements of Electrical Apparatus. Boilers, given during the first term of the Junior year, is followed by Steam Engine, during the second term of the Junior year. Mechanical Technology is given in the summer term at the end of the Sophomore year. This is a course in shop instruction intended principally to familiarize the student with the processes involved in patternmaking, moulding, forging, fitting and finishing. Frequent visits of inspection are made to manufacturing establishments in the vicinity. Following the work in Mechanical Technology, the study of Mechanics of Machinery is pursued during the first term of the Junior year and Engineering Laboratory is given throughout the Senior year. The latter subject includes the calibration of engineering measuring instruments and the performance of practical tests on boilers, engines, and pumps.

The following special studies in Civil Engineering are included in this course: Construction is given throughout the Junior year, consisting of lectures on masonry, foundations, cements and mortars, walls, dams, arches, tunnels, and details of structures; Strength of Materials, given in the first term of the Junior year, is concerned with the theory of beams, columns and shafts, and the method of computing and designing them; the subject includes practical work in the testing laboratory; Hydraulics, given in the second term of the Junior year, treats of hydrostatics and theoretical hydraulics, the flow of water through orifices, weirs, pipes, and channels, naval hydromechanics, and hydraulic motors. Land Surveying, with special reference to location of electric railways, may be taken as an option in the second term of the Junior year.

The study of general Metallurgy and Metallurgy of Iron and Steel is elective during the second term of the Junior year. Lectures given one hour per week on Theory of Electrolysis and Electrometallurgy may be taken as extras during the Senior year.

The special studies in Electrical Engineering which come after Electric Wiring, Dynamos and Motors, and Electricity and Magnetism of the Sophomore year include the following:

Advanced Theory of Electricity and Magnetism, begun in the first term of the Junior year, is devoted to the theory of electrical units and measurements, and to the advanced theory of electrostatics and the magnetism of iron. The accompanying laboratory work is devoted to precise electrical measurements, and the standardization and calibration of electrical measuring instruments. The Theory of Alternating Currents is also begun with the Junior year and is pursued up to the middle of the Senior year; this subject deals with the problems and methods of measurement which are peculiar to the modern practical applications of alternating currents, and with the theory underlying the action of the important types of alternating current machinery and transmission lines.

The subject of Electrical Engineering, beginning in the second term of the Junior year and following as it does the study of Dynamo Electric Machinery, deals with the distribution and utilization of electric power, comparison of systems, feeder regulation, arc and incandescent lighting.

Dynamo laboratory work, beginning in the second term of the Sophomore year, is continued for five terms. The instruction given by a laboratory manual is supplemented by individual direction and supervision in the laboratory. The students work individually or in pairs, and make the more important tests on direct and alternating current generations and motors, rotary converters, transformers, and other electrical apparatus. Carefully written reports of all tests made, with curves plotted from the observations, and discussions of results, are required.

Dynamo Electric Machinery, as already stated, is continued from the Sophomore year through one term of each of the Junior and Senior years. Special attention is paid to the application of electric and magnetic theory to the construction and operation of different types of direct and alternating current machinery.

The Electrical Engineering Seminary continues throughout the Senior year. The work consists of the presentation before the class of papers on assigned topics, supplementing the regular work of the class-room, and of reports on thesis work. The Department reading-room is well supplied with the leading electrical periodicals, American and foreign, and one of the principal objects of the Seminary work is to encourage the systematic reading of the current engineering journals. Reports on articles in the technical French and German periodicals are included as part of the work of the Seminary.

Dynamo Testing is given by lectures and problems beginning with the second term of the Junior year, and continuing through the first term of the Senior year. It treats of standard and special methods of making tests on dynamo machines, transformers, and other electrical apparatus. Most of the methods discussed in the lectures are exemplified by the practical testing done in the dynamo laboratory.

Electric Stations, given in the first term of the Senior year, constitutes an extension of the preliminary work given as Electrical Engineering during the second half of the Junior year. Under this subject are discussed the location, design, and equipment of stations; the selection of suitable prime movers, generators, switchboards, and other apparatus. The use and operation of storage batteries, boosters and other auxiliaries, also receive consideration.

Electric Traction and Power Transmission are both given during the second term of the Senior year. Under Electric Traction are studied the construction, equipment and operation of different types of electric railways. The recent developments in the application of electric motive power to steam railroad conditions are discussed, and the results of tests analyzed. Practice is given in the estimating of the probable cost of building and operating an electric railway to fulfill certain specific conditions.

The subject of Electric Power Transmission deals with the various elements constituting a transmission system. It includes a study of the generating plant, the transmission line, and the receiving systems. Special attention is given to the design, construction, and protection of the line. Under the last three subjects are included visits of inspection to electric light and power stations, and to manufacturing establishments in the Bethlehems and out of town. Central station tests are made and reports required.

Electrical Design is begun in the first term of the Senior year and is pursued throughout the year. The work consists of a series of problems illustrating the application of electromagnetic laws to the calculation and proportioning of electrical machinery for a special duty. Each student makes calculations and drawings for several types of apparatus, including electromagnets, direct and alternating current generators and motors, and transformers. The study of electrical design is intended to reënforce by concrete application the principles underlying the study of dynamo electric machinery.

Graduates receive the degree of Electrical Engineer (E.E.).

THE COURSE IN ELECTRICAL ENGINEERING.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Geometry, (4)	144	Differential Calculus, (4)	145
Chemistry, (2)	390	Elementary Mechanics, (5)	321
Chemical Laboratory, (2)	391	Qualitatitve Analysis, (3)	393
Elementary Mechanics, (2)	320	Stoichiometry, (1)	394
German, (3)	94	German, (3)	95
or French, (3)	74	*or* French, (3)	75
Freehand Drawing, (1)	155	English, (2)	122, 125
English, (3)	120, 121, 125	Gymnasium, (2)	440
Gymnasium, (2)	440		

SUMMER TERM. Constructive Elements of Machinery and of Electrical Apparatus, 201, 350.

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Integral Calculus, (4)	145	Differential Equations, (1)	146
Physics, (4)	322	Analytic Mechanics, (2)	147
Draw'g and Mach. Des., (3)	200	Physics, (4)	323
Elem. Mech. Materials, (1)	185	Machine Design, (2)	202
Electric Wiring, (1)	351	Dynamos and Motors, (3)	352
French, (3)	70	Dynamo Laboratory, (1)	353
or German, (3)	90	French, (2)	72
English, (3)	123, 126, 128	*or* German, (3)	91
		English, (2)	124, 126

SUMMER TERM. Mechanical Technology, 206.

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Theory of Alt. Cur., (2)	357	Electrical Engineering, (1)	361
Elec. and Magnetism, (2)	325	Dynamo Testing, (1)	366
Dynamo Elec. Mach'y, (2)	358	Theory of Alt. Cur., (2)	360
Dynamo Laboratory, (1)	359	Electrical Laboratory, (1)	327
Electrical Laboratory, (1)	326	Dynamo Laboratory, (1)	363
Boilers, (1)	203	Hydraulics, (3)	177
Strength of Materials, (4)	172	Construction, (2)	169
Mech. of Machinery, (2)	207	Steam Engine, (3)	205
Construction, (2)	168	Economics, (1)	17
Economics, (1)	16	Metallurgy, (3)	248-250
		or Land Surveying, (3)	164

SUMMER TERM. Electrical Engineering Inspection, 380.

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Theory of Alt. Cur., (3)	334	Electrical Design, (3)	373
Alt. Current Mach., (3)	365	Power Transmission, (3)	375
Electrical Design, (2)	369	Electric Traction, (3)	374
Electric Stations, (2)	370	Dynamo Laboratory, (2)	377
Dynamo Laboratory, (2)	368	Engineering Lab., (1)	222
Dynamo Testing, (1)	367	Electrical Seminary, (1)	376
Electrical Seminary, (1)	371	Thesis, (4)	381
Engineering Lab., (1)	221		
Advanced Elec. Lab., (1)	328		
Business Law, (1)	20		

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN CHEMISTRY.

This course of study is designed to prepare students for the profession of chemist, in connection with metallurgical establishments, sugar refineries, gas works, manufacturing works, chemical plants, electrical machinery manufactories, mining companies, etc., and the general consulting and analytical work of the professional chemist. It is also well adapted to the preparation of teachers of chemistry and as a course preliminary to the study of medicine.

With these objects in view, the instruction is of such a character as to emphasize the great importance of accurate work, to teach the student to make careful observations and deductions, to develop scientific habits of thought, as well as to give him a knowledge of the principles and facts of chemistry. The instruction is eminently practical, a large portion of it being devoted to laboratory work during the four years necessary to complete the course.

Instruction in Theoretical Chemistry is begun in the first term of the Freshman year, with laboratory work in general inorganic chemistry. Stoichiometry with practice in chemical problems, is taught in the second term of the Freshman year and is followed in the Sophomore year by Chemical Philosophy and Advanced Chemistry. In the second term of the Junior year there is a course of lectures and recitations on Organic Chemistry, with laboratory work.

Qualitative Analysis is taught by lectures and laboratory work in the second term of the Freshman year. This is followed by courses in Quantitative Analysis throughout the Sophomore and first term of the Junior year. This course includes Gas Analysis. Furnace Assaying and the assay of gold and silver bullion are taught in the first term of the Junior year by lectures and laboratory work. Instruction is given in Industrial Chemistry, through the first and second terms of the Senior year. The analysis of various commercial products is taken up in the second term of the Senior year, also the subject of Sanitary Chemistry. Blowpipe Analysis is included in the course.

The practical work in Organic Chemistry is performed in the second term of the Junior year in the organic laboratory. Physical Chemistry is taught by lectures, text-book and laboratory work. In the Senior year the student prepares a thesis on some chemical subject, involving laboratory work.

The laboratory for qualitative analysis is a large, well-ventilated, and well-lighted room, supplied with convenient working tables, vacuum filtration, hoods for noxious vapors, steam baths, gas and washing appliances, and a commodious room for hydrogen sulphide. Distilled water is delivered by faucet in this room and other large laboratories.

The quantitative laboratory is equipped like the qualitative laboratory, but is supplied in addition with apparatus for drying precipitates and residues, rooms for the chemical balances, for combustions, and for a reference library.

The gas laboratory is supplied with full and complete apparatus for gas analysis, according to Orsat's, Hempel's, and Bunsen's processes.

The assaying laboratory is supplied with large working tables, twenty-nine crucible and two iron furnaces, and eight muffle furnaces, with adjoining rooms for balances, and gold and silver bullion analysis.

The laboratory for organic chemistry is equipped similarly to the quantitative laboratory, in addition being supplied with high pressure steam, cold water and air blast upon the working tables, and a full supply of apparatus for the various determinations and experiments, including combustion furnaces, furnaces for heating sealed tubes, Hoffman's, Dumas's, and Meyer's apparatus for vapor densities, nitrometers, chemical balances, etc.

The working laboratories for industrial chemistry contain an apparatus for making illuminating gas, an alcohol still, worm and doubler, and a complete working model of sugar refinery, including filters, vacuum pan, and centrifugal. There is also apparatus for use in the manufacture of chemicals, for dyeing, calico printing, and bleaching. In connection with these laboratories is a room containing a photometer and apparatus for determining the sulphur, ammonia, and specific gravity of illuminating gas; also a laboratory for the testing of alcoholic liquors, sugar, molasses, bone black, soap, petroleum, paints, dyes, superphosphates, tallow, illuminating and lubricating oils, rubber, explosives, asphalts, and other commercial products, with the necessary technical apparatus. The students make practical experiments in this direction, and, with an instructor, visit various industrial establishments in the neighborhood, in Philadelphia and in New York City. Bacteriology includes a course of lectures and laboratory work.

Graduates in this course receive the degree of Bachelor of Science (B.S.) in Chemistry.

THE COURSE IN CHEMISTRY.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Geometry, (4)	144	Differential Calculus, (4)	145
Chemistry, (2)	390	Qualitative Analysis, (3)	393
Chemical Laboratory, (2)	391	Stoichiometry, (1)	394
Elementary Mechanics, (2)	320	Elementary Mechanics, (5)	321
German, (3)	94	German, (3)	95
or French, (3)	74	*or* French, (3)	75
Freehand Drawing, (1)	155	English, (3)	122, 125, 128
Mechanical Drawing, (2)	312	Gymnasium, (2)	440
English, (3)	120, 121, 125		
Gymnasium, (2)	440		

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Integral Calculus, (4)	145	Physics, (4)	323
Chemical Philosophy, (3)	395	Quantitative Analysis, (6)	400
Quantitative Analysis, (5)	396	Quant. Anal. Conf., (2)	402
Quant. Anal. Conf., (1)	398	Advanced Chemistry, (3)	403
Physics, (4)	322	English, (2)	124, 126
English, (2)	123, 126		

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Mineralogy, (5)	268	Organic Chemistry, (4)	409
*Quantitative Analysis, (6)	405	Organic Chem. Lab., (4)	410
Quant. Anal. Conf., (2)	407	General Metallurgy, (2)	245
Blowpipe Analysis, (1)	259	Metallurgy of Iron, (2)	246
Assaying, (3)	412	Metallurgical Probs., (1)	247
		Geology, (5)	271
		Blowpipe Analysis, (1)	269

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Physical Chemistry, (3)	417	Industrial Chemistry, (3)	413
Physical Chem. Lab., (1)	418	Industrial Analysis, (3)	414
Metallurgy, (4)	251	Indus. Anal. Conf., (1)	415
Metallurgical Probs., (1)	252	Sanitary Chem. Lab., (3)	416
Industrial Chem. Lab., (3)	411	Electrometallurgy, (1)	255
Bacteriology, (2)	296	Electromet. Lab., (1)	257
Electrochemistry, (1)	254	Economics, (2)	17
Electrochemical Lab., (1)	256	Thesis, (3)	419
Economics, (2)	16		

The figures in parentheses indicate the number of exercises per week.

*Optional courses in Advanced Quantitative Analysis will be offered from year to year to students properly qualified. For 1912-1913 the course embraces the analysis of Ferro-alloys and the analysis of complex copper slimes.

THE COURSE IN CHEMICAL ENGINEERING.

This course of study is designed to prepare students for the profession of the chemical engineer, engaged in the construction and management of manufacturing establishments involving chemical principles, such as sugar refineries, gas works, superphosphate works, bleacheries, dye works, oil refineries, fertilizer works, soap works, sulphuric acid plants, soda works, chemical plants, metallurgical works, etc.

In addition to many of the subjects in the Course of Chemistry, it includes the subjects of boilers, steam engine, drawing and machine design, constructive elements of machinery, measurement of power, mechanics of machinery, mechanical technology, and work in the engineering laboratory. It also includes electricity and magnetism, dynamos and motors, and work in the electrical and dynamo laboratories.

The time devoted to quantitative analysis is shortened from 896 to 544 hours. This course differs further from the course leading to the degree of Bachelor of Science in Chemistry in that it does not include the subjects of blow-pipe analysis and mineralogy. Should a student desire to gain some knowledge of these or other subjects it is possible, under certain conditions, for him to do so, but he will not be allowed to take up the study of any subject not in the course in Chemical Engineering if he has failed to pass the examinations in any of the required subjects in this course.

The Summer Schools following the end of the Freshman, Sophomore and Junior years are a required part of the course.

In this course the training is essentially chemical and the graduates are primarily chemists with a good knowledge of mechanical and electrical engineering, and with additional training in the special mechanical and electrical appliances of industrial chemistry.

This equipment is considered more valuable for the chemical engineer than a fundamental training in engineering and a somewhat limited knowledge of chemistry, since the problems of the manufacturing chemist are not essentially mechanical ones. Although six years' work covering most of the studies of both the chemical and mechanical courses would be found advantageous for the chemical enigneer, this shorter course, of four years, will meet most of his requirements.

Graduates of this course receive the degree of Chemical Engineer (Ch.E.).

THE COURSE IN CHEMICAL ENGINEERING.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Geometry, (4)	144	Differential Calculus, (4)	145
Chemistry, (2)	390	Elementary Mechanics, (5)	321
Chemical Laboratory, (2)	391	Qualitative Analysis, (3)	393
Elementary Mechanics, (2)	320	Stoichiometry, (1)	394
German, (3)	94	German, (3)	95
or French, (3)	74	*or* French, (3)	75
Freehand Drawing, (1)	155	English, (3)	122, 125, 128
English, (3)	120, 121, 125	Gymnasium, (2)	440
Gymnasium, (2)	440		

SUMMER TERM. Constructive Elements of Machinery and of Electrical Apparatus, 201, 350.

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Integral Calculus, (4)	145	Advanced Chemistry, (3)	403
Chemical Philosophy, (3)	395	Quantitative Analysis, (4)	399
Quantitative Analysis, (3)	397	Quant. Anal. Conf., (1)	402
Physics, (4)	322	Steam Engine, (4)	204
English, (2)	123, 126	Machine Design, (2)	202
Draw. and Mach. Des., (3)	200	Physics, (4)	323
Elem. Mech. Materials, (1)	185		

SUMMER TERM. Mechanical Technology, 206.

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Quantitative Analysis, (4)	408	Organic Chemistry, (4)	409
Engineering Lab., (2)	208	Organic Chem. Lab., (4)	410
Elec. and Magnetism, (2)	325	General Metallurgy, (2)	245
Electrical Laboratory, (1)	326	Metallurgy of Iron, (2)	246
Dynamos and Motors, (2)	354	Metallurgical Probs., (1)	247
Dynamo Laboratory, (1)	355	Engineering Lab., (1)	209
Boilers, (1)	203	Electrical Engineering, (2)	362
Assaying, (3)	412	Electrical Laboratory, (1)	327
Economics, (2)	16	Dynamo Laboratory, (1)	356
		Economics, (1)	17

SUMMER TERM. Engineering Laboratory, 212.

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Physical Chemistry, (3)	417	Industrial Chemistry, (3)	413
Physical Chem. Lab., (1)	418	Industrial Analysis, (3)	414
Industrial Chem. Lab., (3)	411	Indus. Anal. Conf., (1)	415
Metallurgy, (4)	251	Sanitary Chem. Lab., (3)	416
Metallurgical Probs., (1)	252	Electrometallurgy, (1)	255
Bacteriology, (2)	296	Electromet. Lab., (1)	257
Engineering Lab., (1)	220	Geology, (2)	270
Mech. of Machinery, (2)	207	Thesis, (3)	419
Electrochemistry, (1)	254		
Electrochemical Lab., (1)	256		

The figures in parentheses indicate the number of exercises per week.

LIST OF STUDIES.

Following is a complete list of studies offered by the University in its various courses. The number of exercises per week in each subject is indicated by the figure in parentheses. Two hours of drawing, three of work in the laboratory or three of practice in the field are regarded as equivalent to a recitation or lecture of one hour's duration.

UNDERGRADUATE COURSES.

PHILOSOPHY, PSYCHOLOGY, AND EDUCATION.

PROFESSOR HUGHES.

Psychology.

1. General Psychology. Pillsbury's Essentials of Psychology. First term (2).

2. General Psychology, continued. Experiments and special reports. Second term (2).

3. Psychological Studies. The development in the individual and in the race of play and sport, of the different forms of art, of the moral consciousness, and of the religious attitude. First or second term (2).

5. Psychological Topics. Open to all students of the University. First or second term (1).

6. Experimental Psychology. First and second terms (1 or more).

Philosophy.

7. History of Philosophy, Ancient. Bakewell's Source Book. Topical recitations and discussions. First term (2).

8. History of Philosophy, Modern. Bergson's Creative Evolution. Second term (2).

9. Scientific Method. A study of inductive and deductive logic, with considerable attention to the methods of statistical enquiry. Open to Sophomores, Juniors and Seniors. First or second term (2).

Education.

10. Principles of Education. Bagley's The Educative Process. Recitations and observations. First term (2) or with practice teaching (3).

11. History of Education. Recitations. Monroe's Text-book. Second term (2) or with practice teaching (3).

12. Principles and Practice of Teaching. Brown's American High School. Recitations and observations. First or second term (2), or with practice teaching (3).

Science and Scientists.

15. Science and Scientists. This course consists of lectures by several members of the Faculty and assigned readings, treating of the several fields of science, their methods of study, their beginnings and results, with some description of the lives of great scientists and their work. First term (1).

ECONOMICS AND PUBLIC LAW.

PROFESSOR STEWART, DR. SALIERS.

16. Economics. A study of the elementary principles of political economy. Lectures and required reading in selected works. First term (2) or (1).

17. Economics. Practical economic problems: taxation, transportation, finance, labor, trusts and monopolies. Second term (2) or (1).

18. Economics. Finance. Discussion of public expenditures; their nature, their relation to the industrial, political, and social conditions; their relation to the functions of government; also discussion of financial organization and administration. First term (2).

19. Economics. Finance. Discussion of public revenues; of revenue derived from the public domain and public industries; the apportionment, classification, and administration of taxes; the nature and employment of public credit; the origin and growth of public debts. Second term (2) or (3).

20. Economics. Elements of Business Law. The principles of contract; formation of contracts; operation and discharge of contracts; sales of goods; insurance contracts; negotiable instruments. First term (2) or (1).

21. Economics. Elements of Business Law. Principal and agent; master and servant; business associations; partnerships and corporations. Second term (2) or (1).

22. Public Law. Constitutional Law. Studies in Federal and State constitutional law. First term (2).

23. Public Law. Comparative Constitutional Law. Studies of the English, German and French governmental organizations. Second term (2).

24. Public Law. International Law. Its origin and sources; its authority and sanction; state sovereignty; territorial rights of sovereignty; naval or maritime belligerency; the Declaration of Paris. First term (2).

25. Public Law. International Law. The mitigation of war; the modern laws of war; rules as to prisoners and quarter; relations of belligerents on land; rights of capture by land; proposals to abolish war. Second term (2).

26. Accounting. Commercial paper, bookkeeping, accounting, and auditing. Credit instruments, financing operations, business organization and systems, factory accounting. First and second terms (3).

27. Accounting. Purchasing. Marketing, advertising, credit business, and operations, including the practice of Wall Street and other financial centers, mining and transportation accounting. First and second terms (2).

28. Railroad Administration. This course considers from the administrative standpoint railways as factors in the social and industrial development of the United States. It treats of the historical and the geographical conditions of railroad location. The organization of railroads, considering charters and franchises, capital stock, directors and stockholders. The financial and legal aspects of these organizations, and their relation to the public through commissions. First term (2).

29. History of Labor Legislation. The labor movement and its social significance. The progress of the laboring classes, strikes, arbitration, labor organizations. First term (2).

30. History of Theories of Government. The development of political philosophy from the Greeks to the present time, and its connection with political history; a critical study of contemporary political thought and terminology. Second term (2).

31. THEORIES OF SOCIETY. This course deals with the principles underlying social organization and with the nature and development of social institutions. Attention is devoted to the study of the family, the state, and to the problem of race assimilation in the United States. Second term (2).

32. INSURANCE. The historical development of insurance, and a discussion of its economic aspects. The various forms of insurance: fire, accident, employment, and life. Rates, policies, investments, management, and insurance laws. Second term (2).

33. COMMERCIAL GEOGRAPHY. A study of the various natural and artificial conditions which affect commercial and industrial development, followed by a consideration of the more important products and industries of the different countries, with special reference to the domestic and foreign commerce of the United States. First term (2).

HISTORY.

PROFESSOR STEWART, DR. SALIERS.

34. EUROPEAN HISTORY. The formation of the modern European nationalities with particular reference to the growth of France. The rise of the Universities. The Revival of Learning. The Reformation. The relations of Europe and America. Preparation required, if schedule of studies permits: 277. Second term (3).

35. EUROPEAN HISTORY. The history of modern Europe. The development of the power of Great Britain. The French Revolution and the history of the nineteenth century. First term (3).

36. UNITED STATES HISTORY. History of the United States since the adoption of the Federal Constitution. Economic progress of the country previous to 1860. The struggle over secession. Effects of the Civil War upon the economic and social life of the Union. The industrial expansion and its relation to changes of political policies. Second term (3).

37. HISTORY OF COMMERCE. A general survey of ancient, mediaeval and modern commerce, with special stress on the commercial policy of Europe during the last century. First and second terms (2).

38. INDUSTRIAL HISTORY. Special attention is directed to the evolution of modern industrial conditions as found in the growth of the economic power of Great Britain, Germany, and the United States. First and second terms (2).

LANGUAGES.

LATIN.

PROFESSOR BLAKE.

40. Livy. Selections from the books covering the war with Hannibal. Particular attention to forms and the usages of normal syntax. Writing of Latin prose exercises chiefly based upon the selections read. Written translations from Latin into English. History of the struggle between Rome and Carthage. Freshman, first term (3).

41. Horace. Odes and Epodes. Insistence upon tasteful translation. Constant practice in metrical reading. Memorizing of some of the odes of Horace. Writing of brief original dissertations on topics assigned in connection with Horace. Historical review of Roman lyric and elegiac poetry. Freshman, second term (4).

42. Cicero. De Senectute and De Amicitia, together with Latin prose exercises. Freshman, second term (1).

43. Pliny. Selected letters. Tacitus. Agricola and Germania. Consideration of social and legal usages suggested by Pliny. Some study of Roman provincial administration. Sophomore, first term (3).

44. Plautus and Terence. Careful study of a play of each, with rapid reading of as much more as the time permits. Study of dramatic verse-structure and practice in metrical reading. History of the drama at Rome. Sophomore, second term (3).

45. Tacitus. Selections from the Histories or Annals. Some consideration of Tacitus as an historian and a literary artist. Sight-reading from Suetonius. Junior or Senior, first term (3).

46. Juvenal. Selected Satires. Selections from Martial. Satire and epigram in Roman literature. Study of social conditions under the empire as evidenced by the writings of the younger Pliny, Tacitus, Suetonius, Juvenal, and Martial. Writing of brief dissertations on assigned topics. Junior or Senior, second term (3).

47. Lucretius. Careful study of one book entire of De Rerum Natura, with reading of selections from the other books. Consideration of textual questions. Discussion of ancient materialistic theories. Some review of Roman philosophy and ethics. Junior or Senior, first term (3).

48. Roman Law. An elementary course. Selections from the Institutes of Justinian, or Gaius, are read and commented on.

Brief survey of Roman constitutional history and the development and content of the body of Roman Law, in connection with Morey's outlines of Roman Law. Junior or Senior, second term (3).

Reading for honors. Candidates for honors in Latin are assigned readings for the summer vacations, usually the Satires and Epistles of Horace, or selections from Ovid and Virgil and collateral reading in the Sophomore vacation; the assignments for the Junior vacation are varied.

GREEK.

PROFESSOR GOODWIN.

50. XENOPHON. Selections from the Memorabilia, Hellenica, or Cyropaedia. Review of the Grammar. Attic prose syntax is carefully studied, and special attention given to the formation of correct methods of study and translation, to grammatical analysis, and the reading aloud of Greek. Available time is employed in sight-reading. HERODOTUS. One book (begun). One hour a week for the greater part of the term is devoted to Prose Composition and a variety of practical exercises. First term (4).

51. HERODOTUS (continued). Study of the forms and syntax of the Ionic dialect. PLATO. Euthyphro and Apology, or other shorter dialogues. Introduction to Greek Philosophy. Grammar, Composition, and practical exercises as in the first term. Second term (4).

52. THUCYDIDES. One or more books. Practical exercises, including composition, are given usually once in two weeks. First term (3).

53. TRAGEDY. EURIPIDES. Medea, Bacchae, or another play. SOPHOCLES. Oedipus Tyrannus, Antigone, or another. Literary study of the drama. Poetical language, style, and conception. Metrical reading. Composition from time to time. Second term (3).

54. DRAMATIC POETRY continued. AESCHYLUS. Agamemnon, or Prometheus Bound. ARISTOPHANES. Clouds, Frogs, or Birds. ARISTOTLE. Chapters from Poetics. Aristophanes as humorist and as moralist, with consideration of the tendencies which he satirized. Metres. Elementary text-criticism. First term (3).

55. GREEK ORATORY. Jebb's Selections from the Attic Orators. DEMOSTHENES. Selected Orations. The reading is rapid, and the student is supposed to have reasonable facility in understanding the Greek directly without rendering into English. Attention is

directed largely to those points which illustrate the development of Greek prose style. Second term (3).

56. HOMER. Considerable portions of the Iliad or Odyssey are rapidly read. Homeric language, syntax, and metre are reviewed, with some reference to the needs of intending teachers, but chiefly as a foundation for the study outlined in course 57. First term (3).

57. LYRIC POETRY. Fragments of the Elegiac, Iambic, and Melic Poets. Selections from PINDAR, or THEOCRITUS. Study of the development of poetry in Greece. Second term (3).

58. HELLENISTIC GREEK. New Testament. Selections from LUCIAN. Wilamowitz's Griechisches Lesebuch. To be substituted on occasion for 57. Second term (3).

Courses 54 and 56, 55 and 57 are given in alternate years, and are open to both Juniors and Seniors.

Candidates for honors in Greek will be assigned special readings on request.

FRENCH.

PROFESSOR FOX.

70. ELEMENTARY FRENCH. Elementary French Grammar. Easy French texts. First term (3).

71. ELEMENTARY FRENCH, continued. Grammar and Composition. Dictation. Reading of short stories by various authors. Second term (3).

72. FRENCH. Continuation of course 70. Scientific French. Second term (2).

73. FRENCH. Rapid reading of French Prose. First and second terms (2).

74. FRENCH. Thorough review of the Grammar. Composition based on work in the Grammar. Modern French Prose. Dictation. First term (3).

75. FRENCH. Continuation of course 74. Composition. Modern French Prose. Second term (3).

76. FRENCH PROSE AND POETRY. Chateaubriand, Hugo, Balzac, Flaubert, Maupassant, Daudet, Zola. First term (3).

77. FRENCH DRAMA. History of the Development of French Drama from the Classical Period. Collateral reading and lectures. Second term (3).

78. MODERN FRENCH NOVELISTS. Bourget, Barrès, France, Loti, Bazin. Collateral reading and lectures. First and second terms (3).

79. OLD FRENCH. Historical French Grammar. The Evolution of the French Language, with special reference to its influence on English. First and second terms (3).

GERMAN.

PROFESSOR PALMER, DR. WOODS.

90. ELEMENTARY GERMAN. German Grammar and Composition. Easy German texts. First term (3).

91. ELEMENTARY GERMAN, continued. Composition based on work in the Grammar. Dictation. Reading of short stories by various modern authors. Second term (3).

92. GERMAN. More advanced work in the Grammar. Easy composition. Reading of more difficult German prose. First term (2).

93. GERMAN. Continuation of course 92. Composition and dictation. Rapid reading of selections from Scientific German. Second term (2).

94. GERMAN. Thorough review of German grammar. Prose composition. Scientific German. First term (3).

95. GERMAN. Continuation of course 94. Advanced composition. Scientific German. Second term (3).

96. GERMAN. German Prose and Poetry. Heine, Keller, C. F. Meyer, Freytag, Storm, Heyse. Composition. First term (3).

97. GERMAN. Schiller's Dramas. Composition and lectures. Second term (3).

98. GERMAN. Goethe. Dichtung und Wahrheit, Faust: Erster Teil. Lectures and composition. First and second terms (3).

99. GERMAN. Commercial German. Letter writing, reading of books on commerce and economics, conversation, and dictation. First and second terms (3).

100. GERMAN. Nineteenth Century German Drama. Lectures, reading, reports on assigned work. First and second terms (3).

101. GERMAN. Lessing's Life and Works. Lectures, reading and reports on assigned work. First and second terms (3).

102. GERMAN. The German Short Story, its origin and development. Rapid reading of illustrative stories, with particular attention to Gottfried Keller, Theodor Storm, C. F. Meyer, and Paul Heyse. Lectures and reports. First and second terms (3).

103. GERMAN. Middle High German. Wright's Middle High German Primer. Bachmann's Mittelhochdeutsches Lesebuch. Nibelungenlied. First term (3).

104. GERMAN. Middle High German. Gudrun, Wolfram von Eschenbach, Gottfried von Strassburg, Walther von der Vogelweide. Lectures on Middle High German literature. Second term (3).

SPANISH.

PROFESSOR FOX.

110. SPANISH. Spanish Grammar. Reading of easy modern texts. First and second terms (2).

Course 110 is open to Juniors and Seniors. The number of students accepted is limited as the sections are necessarily small.

111. SPANISH. Grammar, reading and composition. Modern Spanish novels and plays. Short outline of Spanish literature. First and second terms (3).

Course 111 is open to all students of the University.

112. COMMERCIAL SPANISH. Preparation required: 111. First and second terms (3).

ITALIAN.

PROFESSOR FOX.

115. ITALIAN. Grammar and composition. Rapid reading of easy modern prose. First term (3).

116. ITALIAN. Dante's Inferno. Interpretation, lectures and outside reading. Second term (3).

ENGLISH.

PROFESSOR THAYER, ASSISTANT PROFESSOR LUCH,
ASSISTANT PROFESSOR MESCHTER, MR. WALTERS.

120. RHETORIC. A composition course based on Genung's Working Principles of Rhetoric, involving recitations and weekly themes on assigned subjects. First term (2).

121. AMERICAN LITERATURE. Lectures on the basis of Trent's History of American Literature. Text-book to be read by the student in sections as assigned. The examination is based upon the text-book and the student's note-book. First term (1).

122. HISTORY OF THE ENGLISH LANGUAGE.. Lectures and class-room work, with the use of Lounsbury's History of the English Language as a text-book, supplemented by Emerson's and Champneys'. Second term (2).

123. ENGLISH LITERATURE. An outline course developed by lectures and recitations, with parallel readings assigned annually.

Text-book: Pancoast's English Literature (revised). First term (2).

124. LITERARY CRITICISM. The subject varies annually between topics taken from Elizabethan Literature, lyric or dramatic, and from XIXth Century Literature, earlier or later period. Second term (2).

125. ESSAYS, on subjects annually assigned, taken from American authors and requiring the previous reading of some specific work. Six essays a year meet this requirement.

126. ESSAYS, on subjects based on English Literature. Six essays a year meet this requirement.

127. ENGLISH LITERATURE of the 19th Century, the periods 1798-1830 and 1830-1900 being given in alternate years. A lecture course based on Saintsbury's XIXth Century Literature. First term (1).

128. ORATORY. A formal course based upon Foster's Argumentation, with recitations and writing of briefs, the composition and delivery of orations, and speeches on topics of current interest. First and second terms (1).

129. ANGLO-SAXON. Sweet's Anglo-Saxon Primer and Reader, with lectures on early English Literature, and readings from Brooke and Earle. First term (3).

130. ENGLISH PHILOLOGY. The principles of the Philology of the English language as developed in the works of Earle, Trench, Morris and Skeat. By a process of elimination the elements derived from Romance and other sources are excluded, and the residuum examined, in vocabulary and grammar, as a Teutonic language; with special reference to the intensive development of the tongue previous to the Age of Chaucer. Preparation required: 129. Second term (3).

131. MIDDLE ENGLISH. A critical study of the English of Chaucer, Langland, Wiclif, and Gower; followed by the literary study of selected specimens of their works. As text-books, The Student's Chaucer (Clarendon Press), Skeat's edition of The Vision of Piers the Plowman, Wiclif's translation of the New Testament revised by Purvey, and Gower's Confessio Amantis are assigned. First term (3).

132. POETICS. A course based on Gummere's Handbook of Poetics, Alden's English Verse, Saintsbury's Loci Critici, and the use of Palgrave's Golden Treasury, and The Oxford Book of

English Verse, with practical exercises in verse-composition. Second term (3).

133. The Danish Element in English. A philological study based on Sweet's Icelandic Primer, Groth's Danish Grammar (pp. 1-29, 67-143) and the works of Jespersen and other philologists. Alternative with 132. Preparation required: 129, 130. Second term (3).

134. Optional courses on the Rise and Development of the English Novel and on the Arthurian Cycle are offered in alternate years. These are both lecture courses, with private reading assigned; and, if supplemented by a rigid examination, will be taken as equivalent to one term's work in any class above the grade of Freshman.

MATHEMATICS AND ASTRONOMY.

PROFESSOR THORNBURG,
PROFESSOR MEAKER, PROFESSOR LAMBERT,
ASSOCIATE PROFESSOR OGBURN, ASSISTANT PROFESSOR MILLER,
ASSISTANT PROFESSOR STOCKER, MR. REYNOLDS.

140. Solid Geometry, beginning with Book VI and completing the subject. First term (3).

141. Trigonometry. Plane Trigonometry, including the use of logarithmic tables. Preparation required: 140. Second term (2).

142. Trigonometry. Spherical Trigonometry, including the use of logarithmic tables. Second term (1).

143. Advanced Algebra, beginning with the Theory of Quadratic Equations and completing the subject. First term (3).

144. Analytic Geometry. Graphic representation of loci on cross-section paper, plane and solid analytic geometry. Preparation required: 141 or 143. First term (4).

145. Differential and Integral Calculus. Embracing applications to analytic geometry problems, theory of center of gravity, moment of inertia, together with a short chapter on elementary ordinary differential equations. Preparation required: 144. Second term (4); First term (4).

146. Differential Equations. Second term (1).

147. Analytic Mechanics. Differential equations of motion, treatment of forces in space, free and constrained motion of a particle and of masses, with applications to practical problems. Preparation required: 145. Second term (2).

148. Descriptive Astronomy. A study of the fundamental facts and principles of the subject with solution of problems; observatory visits. Preparation required: 145 or 144 and 320. Second term (3).

149. Practical Astronomy. Study of instruments used, methods of taking and reducing observations to determine time, latitude, longitude, and azimuth; observatory work in which each student makes his own observations and computations in illustration of the problems studied. As this study is primarily for civil engineers, the sextant and engineer's transit are the chief instruments employed in the observational work. Preparation required: 145, 148. First term (3).

150. Vector Analysis. Second term (2).

FREEHAND DRAWING.

MR. GELHAAR.

155. Freehand Drawing, with special reference to perspective, construction, and machine parts. First term (1).

CIVIL ENGINEERING.

PROFESSOR MC KIBBEN, PROFESSOR WILSON,
ASSOCIATE PROFESSOR CONKLING, ASSISTANT PROFESSOR FOGG,
MR. BECKER, MR. HENDRICKS, MR. HAMMOND.

160. Mechanical Drawing. The use of drawing instruments. Lettering and tracing. Mechanical drawing from objects. Simple projections. Isometric drawing. First term (2).

161. Descriptive Geometry. The descriptive geometry of projections, intersections, and developments. Plans, elevations and sections of simple structural details. Preparation required: 160. Second term (3).

162. Stereotomy. Problems in stone cutting, including plans for piers, culverts, and arches. Isometric drawings and linear perspective. Preparation required: 160, 161. First term (3).

163. Land Surveying. The theory and practice of land surveying, including the computation of areas, dividing land, and determining heights and distances. Map drawing and topographic signs. Field work with the level and transit in the determination of heights and distances, and in making surveys of farms. Map drawing from the student's field notes. Preparation required: plane trigonometry, mechanical drawing. Second term (4); also in summer term, four weeks beginning June 12, 1912.

164. LAND SURVEYING. A short course in land and railroad surveying. Similar to course 163 except that parts of land surveying are replaced by the elements of railroad surveying. Preparation required: plane trigonometry and mechanical drawing. Second term (3).

165. RAILROAD SURVEYING. Reconnaissance, preliminary and local methods, with the theory of curves and turnouts. Location of a line, with the preparation of profiles and maps. The computation of earthwork and estimates of cost. Preparation required: 161, 163. Second term (4).

166. TOPOGRAPHIC SURVEYING. The theory and use of the plane table, and of the transit and stadia. Pen topography. Detailed field work in rough country, and the construction of topographic contour maps. Leveling and triangulation. The adjustment of instruments with the investigation of their systematic errors. Preparation required: 165. Summer term, four weeks, beginning June 12, 1912.

167. GEODETIC SURVEYING. Elements of the method of least squares and the application to the adjustment of triangulations. The figure of the earth. Field work in triangulation, in determination of azimuth, and with the plane table. Preparation required: 144, 147, 148, 165. First term (3).

168. CONSTRUCTION. Lectures covering the history of engineering, including the lives of some of the noted engineers and scientists, the development of building construction, architectural history and a study of the materials of construction. First term (2).

169. CONSTRUCTION. Lectures planned to give the student a general view of the various branches of civil engineering. The lectures cover the subjects of masonry construction in stone and brick, foundations for bridges and buildings, water supply and sewage disposal, development and transmission of water power and the history of bridge construction. Second term (2).

170. RAILROADS. The construction of the roadbed; including ballast, crossties, rails, switches, culverts, and other details. Maintenance of way, and the elements of railroad operation. Visits of inspection, with written reports. Preparation required: 165. First term (2).

171. RAILROADS. Lectures on the economics of railroad location, the arrangement of yards, stations and terminals, train resistance, the application of electricity to the operation of railroads. Preparation required: 170. Second term (2).

172. STRENGTH OF MATERIALS. The elasticity and strength of timber, brick, stone, and metals. Theory of beams, columns, and shafts, with the solution of many practical problems. Preparation required: 320, 321, 322, 145. First term (4).

173. GRAPHIC STATICS. Analysis of the stresses in roof trusses by the force polygon. Applications of the equilibrium polygon to the discussion of beams and girders. Preparation required: 320, 321, 322, 200 or 313. First term (2).

174. GRAPHIC STATICS. Analysis of the stresses in roof trusses by the force polygon. Applications of the equilibrium polygon to beams and girders. Analysis of stresses in bridge trusses. Retaining walls and masonry arches. Preparation required: 320, 321, 322, 172. First term (2).

175. ROADS AND PAVEMENTS. The location, construction and maintenance of roads and pavements. Preparation required: 168, 169. First term (2).

176. ROOFS AND BRIDGES. The theory and computation of stress in roof and bridge trusses under dead, live and wind loads. Locomotive wheel loads on plate girders and bridge trusses. Preparation required: 172, 174. Second term (3).

177. HYDRAULICS. Hydrostatics and theoretical hydraulics. The flow of water through orifices, weirs, tubes, pipes, and channels. Naval hydromechanics. Hydraulic motors. Preparation required: 320, 321, 322, 145. Second term (3).

178. BRIDGE DESIGN. Lectures and drawing exercises. The design of girders and trusses. Computation and drawings are made for a through plate girder railroad bridge and for a highway truss bridge. Preparation required: 172, 176. First term (6).

179. STEEL BUILDINGS. Design of roof trusses and three-hinged arches. Mill building construction. Preparation required: 172, 176. First term (2).

180. BRIDGES AND DAMS.. Higher structures, including continuous, draw, cantilever, and suspension bridges, also metallic arches. The theory and design of masonry walls, dams, and arches. Preparation required: 178. Second term (4).

181. CEMENT AND CONCRETE. The manufacture, properties, and testing of hydraulic cement, mortar, and concrete. Each student makes all the standard tests in the cement laboratory. Reinforced concrete buildings, arches, and other structures; theory of reinforced concrete. Preparation required: 172, 178. Second term (3).

182. HYDRAULIC ENGINEERING AND DESIGN. Systems of water supply, including purification systems, reservoirs, pipe lines, pumping plants. The design of a water supply distribution system. The measurement of flow in open channels by means of tubes and meters. Water power. Irrigation. Preparation required: 177. First term (4).

183. SANITARY ENGINEERING AND DESIGN. Systems of sewerage and methods of sewage treatment and disposal. The design of a sewerage system. House drainage. Preparation required: 182. Second term (3).

184. ENGINEERING INSPECTION. During the vacation between the Sophomore and Junior years each student in Civil Engineering is required to inspect some engineering work and prepare a report thereon. A brief description of the work or structure that the student desires to inspect must be presented to the Professor of Civil Engineering before July 15, and after approval the report thereon must be submitted before September 13. These reports will contain such drawings, photographs and computations as each case may demand, and their length will usually be from twenty to thirty pages of letter paper.

185. ELEMENTARY MECHANICS OF MATERIALS. Brief introduction to elements of strength of beams, columns and shafts, especially as applied to elementary machine design. First term (1).

186. TESTING LABORATORY. Each student makes fourteen experiments in the Fritz Engineering Laboratory, which is equipped with 20,000, 50,000, 100,000, 300,000, and 800,000-pound machines for tension, compression, and flexure, a 50,000-inch-pound machine for torsion and other apparatus for special work. Preparation required: 172. First term (1).

187. HYDRAULIC LABORATORY. Each student makes fourteen experiments in the hydraulic section of the Fritz Engineering Laboratory, which is equipped with pumps, weirs, turbines, waterwheels, meters and other apparatus for special work. Preparation required: 177. Second term (1).

188. THESIS FOR DEGREE OF C.E. Candidates for the degree of Civil Engineer select the subjects of their theses in the first term of the Senior year. Advice is given in regard to the plan of work, and references to literature are indicated. Reports concerning the progress of the investigation are made at intervals during the second term. The thesis is regarded as a part of the final examinations of the course.

For information in regard to the Fritz Engineering Laboratory see page 130.

SUMMER SCHOOLS IN CIVIL ENGINEERING.

SURVEYING. Exercises in Land Surveying and Topographic Surveying, designed primarily for students of the University, but open to all persons prepared to take them, are given in the Summer vacation. In 1912, this work begins at 8 a.m., on June 12 and ends on July 10.

The work of Land Surveying is described under No. 163, on page 84. Students in Mining Engineering are required to take this work at the close of the Sophomore year in connection with some Topographic Surveying. The fee for other persons is $20.

The work in Topographic Surveying is described under No. 166, on page 85. Students in Civil Engineering are required to take this subject at the end of the Junior year. The fee for other persons is $20.

STRENGTH OF MATERIALS. Twenty-six exercises in the classroom will be given in 1912, beginning at 9 a.m., on August 16, and ending on September 13. The laboratory exercises for the testing of materials are not given in this summer course. As this work is a rapid review of the work described under No. 172 it can be taken only by those who study during July and August under instructions which must be obtained from the Professor of Civil Engineering prior to June 4, 1912. This is an optional course and it will not be given unless the number of qualified applicants is at least five. The fee is $25.

INSPECTION REPORT. Inspection of engineering work and a report thereon is required of all students in civil engineering during the vacation following the Sophomore year. This is described under No. 184, on page 87.

MECHANICAL ENGINEERING.

PROFESSOR J. F. KLEIN, PROFESSOR DE SCHWEINITZ,
ASSOCIATE PROFESSOR A. W. KLEIN, ASSISTANT PROFESSOR JONES,
ASSISTANT PROFESSOR HOWARTH, MR. CHILES.

200. DRAWING AND ELEMENTS OF MACHINE DESIGN. Tracings and blue prints. Sketches and working drawings of machine pieces. Interpretation of machine drawing by isometric sketches. General view from given details. Sections of stub ends and valve passages. Intersection of boiler flues. Empirical proportioning of machine parts. First term (3).

201. CONSTRUCTIVE ELEMENTS OF MACHINERY. Visits of inspection. Examination and sketching of machine parts and machinery. A classified and numbered list of some three hundred and sixty items is given to each student, who makes a written report on them with freehand sketches containing the leading dimensions. The class is divided into sections, which are separately taken into shops by the instructor, who then indicates the pieces that are to be examined and gives all necessary explanations. In addition a score of machines of all sorts are taken apart and again put together by this class. This work is accompanied by Constructive Elements of Electrical Apparatus, No. 350. Summer term, four weeks, beginning June 12, 1912.

202. ELEMENTS OF MACHINE DESIGN. Proportioning of such machine parts as come under the head of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers, and connecting rods. Second term (3).

203. BOILERS. Description of various types, and details of construction, staying, setting, etc.; strength of the structure; accessories; fuels and furnaces; operation; wear and tear; visits of inspection to a boiler shop and to a boiler plant. Text-book: Peabody and Miller. First term (1).

204. STEAM ENGINE. Elementary Thermodynamics, theory of the ideal heat engine, properties of steam and efficiency of the steam engine. Mechanics of the engine, steam pressures, inertia resistances, turning force diagrams, etc. Valve gears, valve diagrams applied to slide valves, shaft governors, and link motion. The steam engine indicator and study of diagrams. Outline of the study of economy, compounding, etc. The descriptive work is supplemented by shop visits. The solution of many graphical and numerical problems is required. Text-book: Heck's Steam Engine. Second term (4).

205. STEAM ENGINE. Shorter course. Second term (3).

206. MECHANICAL TECHNOLOGY. Each student is required to give a full written description of the various processes, operations, and tools involved in the production of each one of a series of properly graded examples of patterns, castings, forgings and finished pieces, which are under construction in the shops at the time and drawings for which have been given to him on entering the shops. The student's work is personally directed by an instructor, who accompanies him in each shop, gives necessary explanations, and tests the extent and accuracy of his knowledge.

Four teachers are engaged in this work, one for each shop and section. Summer term, four weeks, beginning June 12, 1912.

207. Mechanics of Machinery. Graphical statics of mechanisms. Determination of the efficiency of a machine and of the forces acting in every one of its pieces and parts. All the problems are given to the students in the form of black prints and consist of a series of suitably graded examples of machinery. In these both frictional and inertia resistances are considered. First term (2).

208. Engineering Laboratory. Use and calibration of apparatus for measuring weight, volume, pressure, temperature, speed, etc., for engineering purposes. First term (2).

209. Engineering Laboratory. Work of 208 continued. Indicator practice, on engines in the laboratory and in factories and power plants in the neighborhood; complete working up of indicator diagrams from simple and compound engines, air compressors, etc. Second term (1).

211. Mechanics of Machinery. Machinery of Transmission. Weisbach-Herrmann series: Vol. III, Part I, Section I. This treats of the Mechanics of Machine Parts and determines their dimensions from considerations of strength and durability. The Introduction is also studied for its excellent analytical presentation of the subject of acceleration. Second term (3).

212. Summer School in Engineering Laboratory. Simple tests with steam; steam calorimeters, injectors, flow of steam, performance of steam-traps, etc.; tests of small steam pumps, of a steam turbine, of engine performance; of hot-air and gas engines, and of an air compressor. Boiler management and testing. Dynamometer work, belt testing, friction and lubrication. Summer term, four weeks beginning June 12, 1912.

216. Thermodynamics. Proof of the fundamental laws; equations of condition for air and superheated steam; the relations between pressure, volume, temperature, work and heat for special changes of state. Establishment of the fundamental equations of thermodynamics and their adaptation to gases and technical problems. Text-book: Zeuner's Technical Thermodynamics. First term (5).

217. Kinematics of Machinery. This treats of the constrained motion peculiar to machinery and of the nature and equivalence of mechanisms. As here pursued it consists of a few lectures accompanied by a large amount of work in the drafting room. The work is expended on the construction of centrodes, on in-

versions and skeletons of mechanisms and also on the preparation of displacement, velocity and acceleration diagrams for a great variety of machines. This is followed by much practice in mass and force reductions, the latter including all forms of inertia resistance and external forces. First term (4).

218. Advanced Machine Design. This covers the design of machines in general, such as machine tools, hydraulic machinery, including pumps, etc., hoists, cranes, etc. Each student is required to design several machines individually, to gain experience in designing and in proportioning the various parts for strength, stiffness and other requirements. First term (5).

220. Engineering Laboratory. Work of 209 and 212 continued. Tests of boilers, of power plants and of pumping stations in the neighborhood. Advanced work along the lines of 212. First term (1).

221. Engineering Laboratory. A shorter course, selected and condensed from 208 to 228 especially in steam engineering, for students in Metallurgical, Mining, and Electrical Engineering, and Electrometallurgy. First term (1).

222. Engineering Laboratory. Work of 221 completed, along same lines. Second term (1).

224. Advanced Machine Design. This is a continuation of course 218, being more specialized. Second term (5).

227. Mechanics of Machinery. Hoists, Pumps, Compressors, Blowing Engines, and Fans. The presentation is that of the Weisbach-Herrmann series. The classroom work is supplemented by suitably timed visits of inspection. Second term (4).

228. Engineering Laboratory. Work of 220 carried forward, along same lines. Analysis of flue gases; complete tests of the power plants of the vicinity. Second term (1).

229. Steam Turbines. The Mechanics, Thermodynamics, Construction and Experimental Results of the Steam Turbine. Text-book: Stodola. Second term (5).

230. Gas Engines. The Mechanics, Thermodynamics, Thermochemistry, Construction, and Tests of the Gas Engine. Text-book and reference-book: Carpenter & Diederichs. First term (3) or (2).

231. Thesis for Degree of M.E. Candidates for the degree of Mechanical Engineer are required to present theses upon topics connected with mechanical engineering. Drawings and diagrams

are required whenever the subjects discussed need such illustration.

For Summer Schools see courses 201 (connected with course 350), 206, and 212, also statement on page 113.

METALLURGY.

PROFESSOR RICHARDS,

ASSOCIATE PROFESSOR LANDIS, MR. DAWSON.

243. Metallurgical Design. Execution of designs accompanied by working drawings and estimates of material and cost for the erection of metallurgical plant under given conditions. Second term (2).

244. Electrometallurgical Design. Execution of designs accompanied by working drawings and estimates of material and cost for the erection of an electrometallurgical plant under given conditions. Second term (2).

245. General Metallurgy. Metallurgical processes. Principles of combustion. Principles of thermo-chemistry. Measurements of high temperatures. Fuels, natural and artificial, solid and gaseous. Fluxing. Refractory materials. Classification of furnaces. Artificial draft and blast. Electric furnaces. Reference books: Schnabel's Allgemeine Hüttenkunde, Fulton's Principles of Metallurgy. Second term (2).

246. Metallurgy of Iron. Chemical and physical properties of iron. Iron ores. Preparation of ores. The blast furnace. The mixer. Remelting. Pig washing. Puddling. The Bessemer process. The open hearth process. Duplex processes. Cementation. Manufacture of crucible steel. Electric steel. Direct processes. Methods of casting and forging. Reference books: Ledebur's Eisenhüttenkunde, Stoughton's Metallurgy of Iron. Second term (2).

247. Metallurgical Problems. A course of fifteen problems embodying the use of the physical, chemical and mechanical principles utilized in practical metallurgy. Reference: Richards' Metallurgical Calculations, Parts I and II. Second term (1).

248. General Metallurgy. Shorter course. Reference books: Phillips-Bauerman's Elements of Metallurgy, Richards' Metallurgical Calculations. For Civil Engineering students, First term (1). For Mechanical Engineering students, Second term (1).

249. Metallurgy of Iron, Steel and Other Metals. Shorter course. First term (1). Second term (1).

250. METALLURGICAL PROBLEMS. A course of problems embodying the use of physical, chemical and mechanical principles utilized in practical metallurgy, particular attention being paid to the needs of the Civil and Mechanical Engineer. As above, First term (1). Second term (1).

Courses 248, 249 and 250 are an abridgment of courses 245, 246, 247, and 251, for students of Civil, Mechanical and Electrical Engineering.

251. METALLURGY OF COPPER, LEAD, SILVER, GOLD, ZINC, TIN, MERCURY, NICKEL, ALUMINIUM, ETC. Copper: Chemical and physical properties. Ores. Smelting sulphide ores. The Bessemer process. Treatment of oxide ores. Wet processes. Electrolytic processes. Lead: Chemical and physical properties. Ores. Smelting processes. Condensation of lead fume. Refining and desilverization of base bullion. Silver: Chemical and physical properties. Ores. Smelting with lead. Amalgamation. Leaching processes. Gold: Chemical and physical properties. Ores. Gold washing. Gold milling. Chlorination. The cyanide process. Parting gold and silver. Zinc: Chemical and physical properties. Ores. Belgian and Silesian processes for the manufacture of spelter. Manufacture of zinc oxide. Electrolytic processes. Mercury: Chemical and physical properties. Ores. Processes of extraction. Aluminium: Chemical and physical properties. Ores. Extraction by electrolysis. Tin, Nickel, Platinum, Antimony, etc.: Chemical and physical properties; Ores; Alloys; Processes of Extraction. Reference book: Schnabel's Handbook of Metallurgy. First term (4).

252. METALLURGICAL PROBLEMS. A course of fifteen problems concerned with the principles utilized in the metallurgy of the non-ferrous metals. Reference: Richards' Metallurgical Calculations, Part III. First term (1).

253. METALLURGICAL LABORATORY. Calibration and use of instruments employed in metallurgical investigations, pyrometers and calorimeters, etc. Determination of efficiencies of furnaces. Roasting and matting experiments. Investigation of leaching processes. Deposit, $10. Second term (1).

254. ELECTROCHEMISTRY. Lectures discussing the phenomena of electrolysis and the various theories proposed to account for them. Special consideration of secondary reactions, and also of the quantitative relations between electrical and chemical energy, and their mutual convertibility. Reference book: Le Blanc's

Text-book of Electro-Chemistry (translated by Whitney and Brown). First term (1).

255. ELECTROMETALLURGY. Lectures discussing the practical applications of electricity to metallurgical processes. Electrolytic and electric furnace plants and practice. Reference books: Borcher's Electric Smelting and Refining. Neuburger's Handbuch der Praktischen Elektrometallurgie. Second term (1).

256. ELECTROCHEMICAL LABORATORY. Quantitative separations and depositions of metals by electrolysis. Experimental determination of the conditions controlling the nature of electrolytic deposits. Electrolysis of salts. Cathodic Reduction. Deposit, $10. First term (1). For students in the course of Electrometallurgy, deposit, $20. First term (2).

257. ELECTROMETALLURGICAL LABORATORY. A continuation of 256, attention being directed more to electrometallurgical processes, as of refining, reduction, etc. Electric Furnace work. Second term (1).

258. METALLOGRAPHY. The study of Alloys: their physical, chemical and microscopic properties together with deductions drawn therefrom. The influence of thermal and mechanical treatment of metals on the physical properties and structure. Lectures and laboratory work. First term (2).

259. BLOWPIPE ANALYSIS. An elementary course in blowpipe analysis considered as a method of qualitative chemical analysis. Illustrated lectures followed by practical testing for thirty-five bases and fifteen acids. Reference books: Plattner's Blowpipe Analysis, latest English edition; Brush-Penfield, Determinative Mineralogy with the Blowpipe. First term (1).

260. BLOWPIPE ANALYSIS. Laboratory work in quantitative blowpipe analysis, dealing particularly with the determination of gold, silver, cobalt, nickel, copper, lead, tin, bismuth, mercury, and analysis of coal. Reference book: Plattner's Blowpipe Analysis, latest English edition. First term (1).

In Blowpipe course 259 a fee of $2 is required; in course 260 a fee of $4.

(Extra courses in the reading of Technical German and French are offered during the second term by the staff of this Department.)

261. THESIS FOR DEGREE OF MET.E. Every student in Metallurgical Engineering is required to present a thesis on some topic connected with this subject.

262. THESIS FOR DEGREE OF EL.MET. The thesis required for this degree will be upon some subject connected with the theory or practice of Electrometallurgy.

For Summer Schools see courses 201, 350, and 206, also statement on page 113.

GEOLOGY.

PROFESSOR MILLER.

ASSISTANT PROFESSOR WHERRY, MR. ESTABROOK, MR. MITMAN.

267. MINERALOGY. Short course. The principles of crystallography with practice in the determination of forms on models and natural crystals. The physical properties of minerals. Methods of study and classification. A study of about one hundred of the common minerals, particularly the rock forming minerals, with practice in identification. First term (4).

268. MINERALOGY. Long course. Similar to 267, but covering two hundred minerals. First term (5).

(A deposit of $5 is required from each student taking course 267 or 268, to cover damage to collections and instruments and the value of supplies furnished him. In case the damage consists only of ordinary wear and tear the amount retained to cover it is about $3 for each student.)

269. BLOWPIPE ANALYSIS. Advanced blowpipe tests and separations. The application of blowpipe methods as primary tests in determinative mineralogy. (A deposit of $2 is required to cover cost of gas, chemicals, and specimens supplied.) Preparation required: 259 and 267 or 268. Second term (1).

270. GEOLOGY. Short course. A course in structural, dynamic, and historic Geology, including the subject of Petrology, the study of rocks without the microscope. The classification of geologic time. Study of the types of life characteristic of the different periods, and the principles of organic evolution which they illustrate; a brief review of the geology of the United States and the physical changes which the country has undergone during its development. Recitations, lectures illustrated by lantern views, laboratory work, and field trips to slate, cement, limestone, serpentine, and gneiss quarries. This course is especially designed for students whose work is not concerned primarily with geology and who do not expect to prepare themselves for the courses in applied geology which follow. Preparation required: 267. Students in the Course of Arts and Science and Chemical Engineering who

have not had Mineralogy may take the lecture and recitation work, omitting the laboratory exercises. Second term (4), (3), or (2).

271. GEOLOGY. Long course. Similar to 270 except more time is given to the study of rocks and more field trips are taken. Each student is required to take detailed field notes on the geology of the region. Essays on geological subjects are assigned from time to time and a number of field trips are held in conjunction with the work. This course is designed for those men who will pursue the technical courses in applied geology which follow. Preparation required: 268. Second term (5).

(A fee of $1 is required of each student taking courses 270 or 271 to cover damage to collections and the value of supplies furnished him.)

272. ECONOMIC GEOLOGY. The non-metallic minerals, their properties, modes of occurrence, sources and uses, are studied in as much detail as time will permit. Preparation required: 267 or 268, 270 or 271. Second term (2).

274. ECONOMIC GEOLOGY. Metallic Minerals. Causes of the formation of cavities in rocks, their relation to metalliferous deposits; discussion of the theories of ore-deposition; the structure, geological horizon and geographic distribution of the principal metallic economic deposits of the United States. Recitations, illustrated lectures, field trips, and laboratory work. For the purpose of studying ore occurrence, visits are made to the zinc mines of Franklin Furnace and Friedensville, the magnetite mines of Dover, New Jersey, and Cornwall, Pennsylvania, the limonite mines of Ironton, and the anthracite coal mines. Each student is required to prepare a series of maps illustrating the location, production, chemistry, and geology of the economic products of the United States. Preparation required: 270 or 271. Second term (3).

275. APPLIED PALEONTOLOGY. A study of the principles of stratigraphy; fossils, their classification and origin; laboratory practice in the determination of the geologic age of formations by the contained fossils. Visits to type localities for certain fossils are held in conjunction with this work. The origin, modes of deposition, physical characters, structure, occurrence, and distribution of stratified rocks. Evidences of evolution among fossils with a study of the underlying principles and causes. Preparation required: 270 or 271. First term (2).

276. Geology of North America. The physiographic provinces of North America, their development and relation to one another; the geological age and geographical distribution of the rocks of which North America is composed; the structure and history of its mountain ranges; the formation of its great lakes and drainage systems; the history of its geological development and origin; reviews of the great surveys that have been made and their history. Lectures and laboratory work. Preparation required: 270 or 271. Second term (3).

277. Physiography. The cosmic relations of the earth; the classification of land forms; the study of their origin, growth, and decay and the factors governing their development; their geographical distribution. Topographic maps; the relation of topography to geologic structure. The response of man and other organic life to an inorganic environment with special reference to the influence of Physiography upon the economic development of countries. Preparation required: 270 or 271. Second term (3) or (2).

278. Field Geology. Geological maps—their use and the methods by which they are constructed. Practice in the actual working out of surface geology. Problems in plotting geology on topographic maps; each student will be assigned a definite area and will be required to make a geological map of it with structure sections. He will also collect a full set of specimens to illustrate the geology. The first part of the course will be devoted exclusively to field work and the notes then taken will be worked up in the laboratory when the weather prevents further out-door work. A fee of $1 is charged to students taking this course. Preparation required: 270 or 271. First term (2).

279. Petrography. The optical properties of minerals and their study with the petrographical microscope. Lectures, recitations, and laboratory work. A laboratory fee of $3 is charged all students taking this course. Preparation required: 267 or 268, 323. First term (2).

280. Petrography. Advanced Course. Practical applications of petrographical work in the study of rocks. Study of the effects of metamorphism upon rocks. Preparation of thin sections. Collection of suites of specimens and study of the rocks colllected. Recalculation of chemical analyses of rocks. Practical work in the preparation of micro-photographs and drawings of thin sec-

tions of rocks. A laboratory fee of $3 is charged all students taking this course. Preparation required: 279. Second term (1).

281. PHYSIOGRAPHY. A study of topographic forms and the processes that have produced them; the weather and climate; and the influence of physical conditions upon the development of countries. Salisbury's Physiography is used as a text-book. First term (3).

282. PHYSIOGRAPHY. A continuation of Course 281. Recitations, lectures, laboratory work, and field trips. In this work a study is made of the physiographic regions of North America and Europe. The student becomes familiar with topographic maps and the preparation of weather and climate charts. Emphasis is placed on the effect that physiographic conditions have in determining the commercial and industrial importance of nations. Second term (3).

283. MINING AND GEOLOGIC LAW. A study of the legal matters that confront a mining geologist. The law in regard to underground waters and mineral products is studied and abstracts of important cases, accompanied by drawings showing the geologic conditions upon which the decisions were made, are prepared. Shamel's Mining and Geologic Law is used as a reference work. First term (1).

BIOLOGY.

PROFESSOR HALL, MR. SIEBERT.

290. BOTANY. An elementary course treating of the structure and classification of plants. Lectures, laboratory work, and reference to text-books. Preparation advantageous: 292. Second term (2).

291. FORESTRY. Lectures, recitations and laboratory work. The lectures cover a brief introduction to botany. This is followed by lectures on dendrology and text-book work on Forestry. The laboratory work is devoted mainly to dendrology and the characteristics of the wood of important timber species. Field trips during the Autumn enable the student to become familiar with the trees of the region. First term (3). Second term (2).

Careful consideration has been given by friends of the University and by the Board of Trustees to the matter of Forestry as one of the very live issues of the day in connection with the general attention that is now being directed to the conservation of our natural resources. It does not appear to the Trustees that

at the present time the call for professional foresters is such as to justify the establishment of a School of Forestry at the University, but it seems that the question is of such great and growing importance that the University should do its part toward calling the attention not only of its students but of the public in the section of country more directly reached by the influence of the University, to the growing need of a better knowledge of the principles involved. To this end, courses of lectures have been instituted to which the public has been invited and special instruction is being given in Forestry in certain of the courses.

In furtherance and support of the cause of Forestry the University has offered free tuition scholarships to graduates of the Pennsylvania State School of Forestry at Mont Alto, to pursue, as special students at this University, courses supplementary and cognate to their studies at Mont Alto.

292. Biology. Lectures, recitations, and laboratory work. The lectures discuss the following topics: (*a*) fundamental conceptions; life, protoplasm, the cell, etc.; (*b*) the structure, development, relationships, habits, and geographic distribution of animals; (*c*) the more important biological theories; variation, heredity, evolution, etc. In the laboratory, types of the various phyla are dissected and drawings made. First term (3).

293. Comparative Anatomy of Vertebrates. Lectures on the comparative anatomy of vertebrates, with a more extended discussion of biological theories. The laboratory work consists of the dissection of types of the several vertebrate classes. Preparation required: 292. Second term (3).

294. Vertebrate Embryology. Lectures, reading and laboratory work. By the study of living, preserved, and sectioned material, the successive stages of cleavage, gastrulation, and the formation of organs are demonstrated. Preparation required: 293. First term (2).

295. Sanitary Biology. Lectures, recitations, assigned reading and laboratory work. Study of bacteria; microscopical appearance, methods of staining, plate and tube cultures, etc. The quantitative and qualitative bacteriological and microscopical examination of water. Second term (2).

296. Bacteriology. Recitations and laboratory work. After the general study of bacteria, special attention is paid, in this course, to those forms which are economically important, such

as those of water, foods, dairy products, soils, etc. Preparation advantageous: 290 or 292. First term (2).

(A fee of $3 is required in courses 292, 295, and 296, to cover cost of material and breakage.)

DR. ESTES.

299. Hygiene. Lectures intended to teach the students some idea of the importance and the methods of personal hygiene and sanitary laws will be given during the course. It is also intended to suggest to young men who may become engineers, miners, and explorers the importance of and how to take proper measures for the sanitary comfort and personal well-being of men who may, in after life, be under their control and leadership.

MINING ENGINEERING.

PROFESSOR ECKFELDT, MR. SMITH, MR. BARTLETT.

300. Prospecting. Modes of occurrence of minerals. Uses of Geology. Prospecting for placer, vein and bedded deposits. Magnetic prospecting. Preliminary boring. Sampling. Valuation of property. Location of claims. Patents to mining ground. Preparation required: 270 or 271. First term (1).

301. Boring. Uses of bore holes. Methods: by rotation; by percussion with rods and ropes. Special methods: shaft sinking by boring. Survey of bore holes. Preparation required: 270 or 271. First term (1).

302. Mining. Location of plant; breaking ground; tools and machines. Explosives; laws; blasting. Shaft and slope sinking. Tunneling. Supporting excavations; timber, metal, masonry. Development of deposits. Systems of mining underground and at surface. Preparation required: 270 or 271. First term (1). Second term (1).

303. Transportation. Hoisting: Motors, ropes, and attachments. Receptacles. Safety appliances. Laws. Systems of hoisting. Haulage: Surface and underground. Motors, vehicles. Systems: wire rope; aerial tramways. Loading and unloading; stocking and storage of minerals. Transportation of workmen. Signaling. Preparation required: 320. Second term (1).

304. Drainage. Surface water. Prevention of access. Dams. Drainage by tunnels. Mechanical drainage; hoisting water; pumping. Classes of pumps. Classes and positions of motors. Preparation required: 320. Second term (1).

305. VENTILATION AND LIGHTING. Atmosphere of mines. Pollution. Natural and artificial ventilation. Systems. Classes and efficiencies of ventilators. Testing air. Instruments. Laws. LIGHTING: Methods. Dangers. Laws. Safety-lamps. Lighting by electricity. Preparation required: 320-323. Second term (1).

306. ACCIDENTS. Classes. Causes. Means of prevention. Rescue. Hygiene of mines; rules and laws. First aid to injured. Second term (1).

307. MINE AND RAILROAD CONSTRUCTION. The use of stone, brick, cement, concrete, metal and timber with special reference to mining plant. Foundations, piling, dams, reservoirs, retaining walls, mine buildings, railroads, trestles, tipples, ore-bins and docks. Preparation required: all of preceding subjects. First term (2).

308. MINE ADMINISTRATION. Management, organization, employment of labor, mine accounts, etc. Preparation required: all of preceding mining subjects. Second term (1).

309. ORE DRESSING. Theory of ore dressing. Physical principles involved. Machines used in wet, dry, and magnetic methods; order of arrangement. Processes. Location of works. Preparation of anthracite and bituminous coal. In connection with this course, required trips are made to mills and to anthracite breakers. Preparation required: 267 or 268. First term (2).

310. ORE DRESSING LABORATORY. Experimental studies and tests of machines and processes used in the preparation of ores and coal. Deposit, $10. Preparation required: 267 or 268, 201, and 350. First term (1).

311. MINE SURVEYING; RAILROAD SURVEYING. Instruments. Forms of notes. Outside work. Determination of meridian. Inside work. Connecting outside and inside work through shafts, slopes, or tunnels. Calculation of notes; mapping. RAILROAD SURVEYING: preliminary and location methods; theory of curves, turnouts, etc. Care of maps. Detection of errors. Special problems. Fee, $1. Preparation required: 163. Summer term at the end of Junior year, four weeks, beginning June 12, 1912.

312. MECHANICAL DRAWING. The use of instruments. Tracing and lettering. Descriptive Geometry; isometric and orthographic projections; intersections and developments of cylinders, cones, spheres, etc. Sketches and working drawings of machine parts. Blue printing. Fee, $1. First term (2). Second term (2).

313. DRAWING AND DESIGN. Continuation of 312. Designing of machine parts, such as bolts and nuts, screws, bearings, shafts, pulleys, gearing, etc. First term (2). Second term (4).

314. METALLURGICAL CONSTRUCTION. Examination and sketching of parts of metallurgical plants in the vicinity. General views and drawings of metallurgical plants, accompanied by recitations and reports on construction and operation. Preparation required: 312, 313. First term (3).

315. MINING DESIGN. The design of parts of mining plant to meet given conditions, with detailed working drawings, accompanied by estimates of material and costs. Preparation required: 312, 313, 172, and mining subjects. Second term (4) or (2).

316. THESIS FOR DEGREE OF E.M. Candidates are required to present a thesis on some topic connected with mining engineering. With the approval of the professors concerned a subject may be taken from some topic in the geological, metallurgical, or other department.

For Summer Schools, see courses 201, 350, 163, 166, and 311, also statement on page 113.

For description of the Eckley B. Coxe Mining Laboratory, see page 131.

PHYSICS.

PROFESSOR FRANKLIN, ASSOCIATE PROFESSOR MAC NUTT, ASSISTANT PROFESSOR WILY, MR. CHARLES, MR. FRY, MR. PERLEY, DR. GOWDY.

420. ELEMENTARY MECHANICS. Lecture demonstrations and recitations. First term (2).

321. ELEMENTARY MECHANICS. Lecture demonstrations, recitations and laboratory work. Second term (5).

322. ELEMENTARY PHYSICS. Heat and Electricity and Magnetism. Lecture demonstrations, recitations and laboratory work. The laboratory work is devoted partly to Mechanics. First term (4).

323. ELEMENTARY PHYSICS. Light and Sound. Lecture demonstrations, recitations and laboratory work. The laboratory work is devoted partly to Electricity and Magnetism. Second term (4).

324. ELEMENTARY PHYSICS. A brief general course. Lecture demonstrations and recitations. First term (4).

325. ADVANCED THEORY OF ELECTRICITY AND MAGNETISM. Lectures and recitations. First term (2).

326. ELECTRICAL LABORATORY. Precise measurements. First term (1).

327. Electrical Laboratory. Precise measurements. (Continuation of 326.) Second term (1).

328. Electrical Laboratory. Experimental studies and tests chiefly in electrolysis and photometry. First term (1).

329. Theoretical Physics. Elective courses are offered in the Theory of Heat, in the Theory of Electricity and Magnetism, and in the Theory of Optics. Arrangements as to topic and as to time to be devoted to it are made for each group of students who elect Theoretical Physics. First or second term (3) to (5).

330. Physical Research. Special advanced students may elect to pursue experimental investigations in Physics. Arrangements as to topic and as to time to be devoted to it are made for each individual student. First or second term (2) to (4).

334. Theory of Alternating Currents. Theory of Electric Waves. First term (3). Second term (2).

A fee of $6 is required in connection with courses 321, 322, 323, 326, 327, 328, and 330.

ELECTRICAL ENGINEERING.

PROFESSOR ESTY, ASSISTANT PROFESSOR SEYFERT,
MR. FOSTER, MR. GRUBER, MR. HASKELL.

350. Constructive Elements of Electrical Apparatus. Studies of electrical machinery and appliances with the object of familiarizing the student with principles of operation, structural details, and practical uses. The student is supplied with a complete printed outline of the work to be done containing full instructions and explanations. The work consists of three parts, as follows: (*a*) Illustrated lectures, (*b*) Inspection and sketching of electrical machines and apparatus, and (*c*) Visits of inspection to neighboring electric light and power plants. Written reports are required on each day's work. Fee, $3. This work is accompanied by Constructive Elements of Machinery, No. 201. Summer term, four weeks, beginning June 12, 1912.

351. Electric Wiring. Systems of direct current distribution; wiring formulas and applications; installation of electrical machinery and apparatus; interior wiring, overhead and underground construction; rules and regulations of the National Board of Fire Underwriters. Preparation required: 350. First term (1).

352. Dynamos and Motors. Review of elementary electricity and magnetism with special reference to their application to the dynamo. The construction, operation and control of direct cur-

rent machinery; practical operation and management of dynamo machines; station equipment; cost of electrical energy; electromagnets, magnetism of iron; characteristic curves, armature windings. Illustrative problems. Preparation required: 322, 351. Second term (3).

353. Dynamo Laboratory. Introductory course supplementing the class work of 352. Experimental studies and tests of direct current generators, motors, and appliances, for characteristics, regulation, efficiency, insulation, etc. Fee, $6. Preparation required: 322, 351. Second term (1).

354. Dynamos and Motors. This is an abbreviated course adapted to those students who do not continue this subject in the following year. Special attention is given to the operation, regulation, management and methods of testing of dynamos and motors. Illustrative problems. Preparation required: 322. First term (2).

355. Dynamo Laboratory. Introductory course supplementing the class work of 354 or 372. Experimental studies and tests of direct current generators and motors for characteristics, regulation, efficiency, etc. Fee, $6. Preparation required: 322. First or Second term (1).

356. Dynamo Laboratory. Continuation of 355 and supplementing the class work of 362 or 379. Advanced testing of direct current machines; practice is given in operating and testing alternating current apparatus. Fee, $6. Preparation required: 355, and 354 or 372. First or Second term (1).

357. Theory of Alternating Currents. A general survey of the elementary theory of alternating currents. Lectures, recitations and problem work. Preparation required: 352 or 354. First term (2). Second term (2).

358. Dynamo-Electric Machinery. Continuation of 352. Advanced study of dynamo and motor characteristics, theory of regulation, armature windings, armature reactions; illustrative problems. Preparation required: 352. First term (2).

359. Dynamo Laboratory. Continuation of 353. Advanced testing of direct current machines. Fee, $6. Preparation required: 352, 353. First term (1).

360. Theory of Alternating Currents. Continuation of 357. Advanced theoretical studies of alternators, synchronous motors, and synchronous converters. Preparation required: 357, 358. Second term (2).

361. ELECTRICAL ENGINEERING. Continuation of 358. General survey of the more important industrial applications of electricity. Systems of transformation, distribution, and transmission by direct and alternating currents; feeder regulation; arc and incandescent lighting. Preparation required: 357, 358. Second term (1).

362. ELECTRICAL ENGINEERING. Continuation of 354. Similar in general scope to 361 but particularly adapted to students who do not further specialize along the technical lines therein outlined. Special attention is given to outside and interior wiring; overhead and underground line construction. The latter part of this study is devoted to the standard types of alternating current machines, including alternators, motors, rotary converters and transformers, being supplementary to 357. Preparation required: 354, 355. Second term (2).

363. DYNAMO LABORATORY. Continuation of 359. Advanced testing of direct current machines. Fee, $6. Preparation required: 357, 359. Second term (1).

365. ALTERNATING CURRENT MACHINERY. Study of the structural details, characteristics and operation of alternators, alternating current motors, rotary converters, and transformers; illustrative problems. Preparation required: 360, 361. First term (3).

366. DYNAMO TESTING. Lectures on the methods of testing electrical machinery and apparatus, including direct current generators, motors, and motor-generator sets. Special methods of testing large machines; commercial tests as carried out by the large manufacturing companies. Preparation required: 357, 358, 359. Second term (1).

367. DYNAMO TESTING. Continuation of 366. Lectures on testing of alternating current machinery and apparatus, including generators, motors, rotary converters, transformers, induction regulators, etc. Preparation required: 360, 366. First term (1).

368. DYNAMO LABORATORY. Experimental studies and tests of alternating current generators and motors, synchronous converters, transformers, and auxiliary apparatus; measurement of power in polyphase circuits. Fee, $12. Preparation required: 360, 361, 363. First term (2).

369. ELECTRICAL DESIGN. Calculations of electromagnetic mechanisms and direct current dynamo-electric machinery; a graded series of problems leading up to original designing; drafting. Preparation required: 360, 361, 363. First term (2).

370. Electric Stations. Consideration of prime movers; generating machinery, discussion of types and operation; auxiliary machinery and transformers; storage batteries and their application; switch-boards, measuring and protective devices; design and arrangement; station characteristics; sub-stations; operation and management; visits to neighboring plants. Preparation required: 355 or 356, 361 or 362. First term (2).

371. Electrical Engineering Seminary. A weekly meeting is held in the department reading room for discussion of topics from the current journals of theoretical and applied electricity. Presentation of papers on assigned topics; new inventions and discoveries critically reviewed. Preparation required: 357, 361. First term (1).

372. Electrotechnology. Review of the principles of electricity and magnetism, with special reference to their application to dynamo electric machinery; the elementary theory of direct current generators and motors; ratings and guarantees; practical operation of dynamos; station equipment; cost of power, systems of metering; electric distribution and wiring; electric lighting. Illustrative problems. Preparation required: 322. First term (2).

373. Electrical Design. Continuation of 369. Calculations of alternating current apparatus, including generators, motors, transformers, and rotary converters leading up to original designing; drafting. Preparation required: 369. Second term (3).

374. Electric Traction. The construction, equipment and operation of different types of electric railways. The application of electric traction under steam railroad conditions; the dynamics of electric train movement; predeterminations of speed-time curves and the power required for different types of runs. Choice of car equipment; cost of construction and of operation. Testing of railway systems. Visits of inspection to power plants are made and reports required. Preparation required: 365, 370. Second term (3).

375. Electric Power Transmission. The long distance transmission of power by electricity for use in lighting, traction, mining and manufacturing work. Comparison of electric transmission and other systems. The design, construction, maintenance and protection of lines; the effects of inductance and capacity on the operation of the power systems; the generating plant and receiving systems. Preparation required: 357 or 365, 361 or 362, 370. Second term (3).

376. Electrical Engineering Seminary. Continuation of 371. Reports on thesis work are presented and discussed. Preparation required: 371. Second term (1).

377. Dynamo Laboratory. Continuation of 368. Alternating current testing; methods of determining the regulation of alternators; tests on single-phase induction and series (commutator) motors. Fee, $12. Preparation required: 365, 366, 368. Second term (2).

378. Dynamo Laboratory. Experimental studies and tests of direct and alternating current machines. Adapted to students who have not taken 360, 365, 366, 368. Fee, $12. Preparation required: 356. Second term (2).

379. Electrotechnology. General survey of the more important industrial applications of electricity with special reference to the requirements of mining engineering. Elementary theory of alternating currents with application to machinery; comparison of systems of power transmission and distribution; illustrative problems. Preparation required: 372. Second term (2).

380. Inspection Report. During the vacation between the Junior and Senior years each student in Electrical Engineering is required to inspect some electric railway system, lighting or power plant, or other electrical installation, and prepare a written report thereon. A descriptive outline of the installation which the student proposes to inspect must be submitted to the Professor of Electrical Engineering before July 15th, and after approval the detailed report must be handed in before September 19th. These reports should contain such calculations, photographs, drawings and plots as each individual case may require.

381. Thesis for Degree of E.E. Each candidate for the degree of Electrical Engineer is required to present a thesis upon a subject chosen by the candidate during the first term of the Senior year. The work upon which the thesis is based is done during the second term, and it consists in part of reading from references furnished by the professor in charge, and in part of independent work in theory, experimental research, or designing. Reports of progress on thesis work are required from time to time during the term. Much importance is attached to the thesis as evidence of the candidate's ability to carry out an independent investigation. Second term (4).

A fee of $6 for each term-hour (period) of dynamo laboratory work taken per term is required of each student.

For Summer Schools see Courses 201, 350, 206, and 380, also statement on page 113.

CHEMISTRY.

PROFESSOR SCHOBER, ASSOCIATE PROFESSOR ULLMANN, ASSOCIATE PROFESSOR BABASINIAN, MR. DIEFENDERFER, MR. BECK, MR. CRESSY, DR. WILSON, MR. MA GUIRE, MR. ODOM.

390. Elementary Chemistry. Description of the non-metallic and metallic elements and their compounds. Lectures illustrated by experiments, diagrams, working drawings, and specimens from the museum. Note-books on the lectures required. Text-book: Remsen's Chemistry, Briefer Course. First term (2).

391. Chemical Laboratory. Experiments covering a systematic study of the chemical and physical properties of the more important elements and their compounds. Text-book: Remsen's Chemistry, Briefer Course. First term (2).

392. Theoretical Chemistry. This course is intended for those students who have passed the examination in Elementary Chemistry held on the first Saturday of the term. Text-book: Tilden's Introduction to Chemical Philosophy. First term (2).

393. Qualitative Analysis. Practical work in the qualitative laboratory, accompanied by lectures and recitations. Text-book: Treadwell's Analytical Chemistry, Vol. I. Second term (3).

394. Stoichiometry. Chemical problems, and reactions. Text-book: Whiteley's Chemical Calculations. Second term (1).

395. Chemical Philosophy. Lecture Course. Theories of Chemistry; physical and chemical methods of determining atomic and molecular weights, radio-activity, solutions, electrolysis, thermo-chemistry, etc. First term (3).

396. Quantitative Analysis. Practical work in the quantitative laboratory, accompanied by lectures and recitations. Acidimetry, alkalimetry, chlorimetry, and the determination and analysis of simple chemical compounds and ores. Text-book: Treadwell's Analytical Chemistry, Vol. II, Fresenius's Quantitative Analysis. First term (5).

397. Quantitative Analysis. Shorter course. Practical work in the quantitative laboratory. Analysis of simple chemical compounds, ores, and metallurgical products. First term (3).

398. QUANTITATIVE ANALYSIS CONFERENCE. Lectures and recitations concerning the laboratory work of courses 396 and 397. First term (1).

399. QUANTITATIVE ANALYSIS. Continuation of course 397. Second term (5), (4), or (3).

400. QUANTITATIVE ANALYSIS. Continuation of the course 396. Analysis of minerals, ores, slags, alloys, etc. Text-books: Treadwell's Analytical Chemistry, Vol. II, Fresenius's Quantitative Analysis, Blair's Chemical Analysis of Iron. Second term (6).

402. QUANTITATIVE ANALYSIS CONFERENCE. Lectures and recitations concerning laboratory work of courses 400 and 399. Second term (2) or (1).

403. ADVANCED CHEMISTRY. The elements and their compounds. Text-book: Remsen's College Chemistry. Second term (3).

405. QUANTITATIVE ANALYSIS. Continuation of course 400. Ores and alloys; complete analysis of iron and steel; also gas analysis, mineral water analysis, etc. Text-books: Treadwell's Analytical Chemistry, Vol. II, Fresenius's Quantitative Analysis, Hempel's Gas Analysis. First term (6).

407. QUANTITATIVE ANALYSIS CONFERENCE. Discussions concerning the laboratory work of course 405. First term (2).

408. QUANTITATIVE ANALYSIS. Continuation of course 399. Analysis of ores and metallurgical products, and gas analysis. First term (3) or (4).

409. ORGANIC CHEMISTRY. Lectures and recitations. Typical compounds of carbon, their classification, general relations, and methods of preparation of important compounds. Text-book: Bernthsen's Organic Chemistry, translated by Sudborough. Reference book: Richter's Organic Chemistry, translated by Smith. Second term (4).

410. ORGANIC CHEMISTRY. Laboratory work. Determinations of specific gravities, melting points, boiling points, vapor densities; quantitative determinations of carbon, hydrogen, nitrogen, and the halogens. The preparation of about thirty-five pure organic compounds. Text-books: Gattermann-Schober's Practical Methods of Organic Chemistry, Henle's Anleitung für das organisch präparative Prakticum. Second term (4), (3), or (2).

411. INDUSTRIAL CHEMISTRY. Preparation of a number of chemically pure inorganic salts from minerals, commercial products, etc.; of various dyes and dye mixtures, and the dyeing of cotton, silk, and woolen fabrics; calico printing; fermentation; bleaching. First term (3).

412. Assaying. Lectures and laboratory practice in the furnace assay of the ores of lead, tin, antimony, gold, silver, and iron; also gold and silver bullion analysis by processes used in the United States Mint. Text-book: Lodge's Notes on Assaying. First term (3).

413. Industrial Chemistry. Lectures on the chemical industries, illustrated by experiments, diagrams, and specimens from the museum of chemistry. Second term (3).

414. Industrial Analysis. Analysis of commercial products. Laboratory work. Text-book: Allen's Commercial Organic Chemistry. Second term (3).

415. Industrial Analysis Conference. Lectures concerning the laboratory work of the course 414. Second term (1).

416. Sanitary Chemistry. Qualitative and quantitative examination of air, water, food, disinfectants, baking-powders, flour, bread, tea, coffee, cocoa, spices, milk, butter, lard, beer, and other substances connected with this branch of the science. Second term (3).

417. Physical Chemistry. Lectures and recitations. Text-book: Walker's Physical Chemistry. First term (3).

418. Physical Chemistry. Laboratory work. Determination of molecular weights and physico-chemical measurements. First term (1).

419. Thesis for Degree of B.S. of Ch.E. A Candidate for the degree of B.S. in Chemistry or of Ch.E. is required to present a thesis on some subject, approved by the Professor of Chemistry, involving practical work in the laboratory and use of the library. The thesis is regarded as part of the final examinations of the courses. Second term (3).

Deposits to cover breakage, chemicals, etc., are required in the above courses, as follows: Ten dollars each in courses 414 and 418; fifteen dollars in courses 391, 416, and 419; twenty dollars in course 408; twenty-five dollars in courses 393, 397, and 411; thirty dollars each in courses 396, 399, 400, 405, and 412; forty dollars in course 410. The unused portion of the deposit is returned to the student.

Summer Schools. Courses in Qualitative Analysis and Stoichiometry begin July 24, 1912, and continue four weeks. The course in Quantitative Analysis begins on the same date and continues for five weeks. The course in Assaying begins August 28. They are open to all persons prepared to take them.

PHYSICAL EDUCATION.

PROFESSOR REITER, MR. KIMBALL.

440. Gymnasium. Class exercises consisting of setting-up work for correct carriage. Work with dumb bells, wands, and Indian clubs to stimulate circulation, respiration, muscular action, coördination and grace. Squad work on the heavy apparatus is given to develop strength in the larger muscles; recreative work in games and competitive exercises, to develop the play and combative elements. Students desiring to become proficient in advanced apparatus work may avail themselves of the opportunity of receiving special instruction by becoming candidates for the gymnasium team. Special instruction is also given in boxing, wrestling and fencing. Stress is laid upon athletic and aesthetic dancing. Voluntary classes in gymnasium work are conducted for upper classmen. Short talks are given to the Freshmen on personal hygiene and the physiology of exercise. Entering students are given a thorough physical examination, and special advice on postural and physical defects. Each student receives a plotted card showing him his defects and his relation to the normal student. The privilege of a second physical examination is given him, showing a comparative statement and plotting of his physical condition. First and Second terms (2).

441. First Aid to the Injured. This course is designed to give the student a practical knowledge of the most efficient methods of giving first aid to the injured. A brief resumé of the important points in Anatomy will be taken up, followed by consideration of shock, dislocation, fractures, rabies, hemorrhage, burns, sunstroke, frost bite, electricity and lightning stroke, poisons and their antidotes, drowning, asphyxiation, railroad and mining injuries. Students will be required to do practical work in bandaging, applying splint and tourniquets, and to become familiar with the ordinary first aid materials and methods of transporting the injured. Second term (1).

CONFERENCE DEPARTMENT.

PROFESSOR LAMBERT, PROFESSOR PALMER, MR. CHARLES, MR. MA GUIRE.

The Conference Department provides extra instruction in Mathematics, Modern Languages, Physics, and Chemistry for Freshmen and Sophomores. Provision is made for two classes of students.

Class A. Any student who wishes to clear up some difficulty in the Mathematics, Modern Languages, Physics, or Chemistry of the Freshman or Sophomore year, should consult the teachers in the Conference Department on Wednesday and Saturday afternoons.

There is no fee for Class A students.

Class B. Students who are advised by the Dean or by the Heads of Departments or by the Committee on Standing of Students to take extra instruction in the Conference Department, or students who decide to do so of their own volition, can arrange for extra instruction for any period not less than one week by consulting the Director of this Department, who will be found in his office in Packer Hall at 6:45 P.M. on Monday, Tuesday, Thursday, and Friday of each week. The hours of instruction are from 7 to 8 and 8 to 9 on the evenings of these four days.

The Fee of Class B Students, $1.50 for four consecutive recitations, must be paid in advance to the Bursar.

The Conference Department offers to students of the Freshman and Sophomore years an opportunity of reviewing Mathematics, Modern Languages, Physics, and Chemistry during the vacations occurring in the college year, under competent direction. The fee for vacation work is the same as the fee of Class B students.

EXTENSION COURSES FOR TEACHERS AND FOR BUSINESS MEN.

During the year 1911-1912 courses are offered primarily for teachers in the following subjects: American History, Professor Stewart; Biology, Professor Hall; History of Education, Educational Psychology, and Elementary Logic, Professor Hughes; Latin Literature, Professor Blake; Physiography, Professor Miller; German, Professor Palmer. The work done in these courses is distinctly of college grade, and is in each case the equivalent of two-term hours of undergraduate work. In the course in the History of Education, graduate students may arrange with the Professor in charge to take extra work of such a character that the course may count as a graduate course in the department of Philosophy and Education. Examinations will be offered at the close of each course, and credit will be given, with certificates, for the work done.

For further information concerning these courses inquiry should be made of the Registrar, or of Professor Hughes. Circulars will be issued as soon as the courses for the year 1912-13 are definitely ascertained.

SUMMER SCHOOLS.

The Summer Schools in shop inspection and sketching of machine parts, at the end of the Freshman year in the courses of Mechanical Engineering, Electrical Engineering, Metallurgical Engineering, Electrometallurgy, Mining Engineering, and Chemical Engineering, and in Mechanical Technology at the end of the Sophomore year in these courses with the exception of the Mining course, the Summer School in Topographic Surveying in the course of Civil Engineering at the end of the Junior year, and in the course of Mining Engineering at the end of the Sophomore year, the Summer School in Mine and Railroad Surveying, and course of Mining Engineering at the end of the Junior year, and also the Summer School in Engineering Laboratory in the courses of Mechanical Engineering and Chemical Engineering at the end of the Junior year are required studies and are therefore to be regarded as the Summer terms of these courses. Likewise the instruction in Land Surveying at the end of the Sophomore year is required of the students in the course of Mining Engineering, but is extra for the students in the course of Civil Engineering at the end of the Freshman year, for the reason that this subject is regularly scheduled in the second term of the Sophomore year, and students desiring to take it out of the regular course pay for it as an extra. Students not connected with the University may be admitted to the courses in Surveying if properly qualified. For this purpose special arrangement must be made with the Professor of Civil Engineering for the courses in Land and Topographic Surveying, and with the Professor of Mining Engineering for the course in Mine and Railroad Surveying.

In addition to this required Summer work, there are also Summer schools in Mathematics, Astronomy, Mechanical Drawing, Strength of Materials, Chemistry, Physics, German, French, Mineralogy, and Metallurgy designed primarily for students of the University who are deficient in these subjects. But others not connected with the University may be admitted if properly qualified. These last mentioned Summer schools, with the exception of the Summer schools in Chemistry, begin in August; the Summer schools in Chemistry begin on July 24th. A special circular giving details, fees required, etc., will be sent to those applying for it.

GRADUATE COURSES.

The degree of Master of Arts is conferred upon any candidate, otherwise properly qualified, who, after having taken the degree of Bachelor of Arts at any college or university, shall pursue for at least one year at this University a course of liberal study in two departments (under two professors), pass the examinations of the same, and present a satisfactory thesis.

The degree of Master of Science is conferred upon any candidate, otherwise properly qualified, who, after having taken the degree of Bachelor of Science or a degree in technology at any college or university, shall pursue for at least one year at this University a course of advanced study in two departments (under two professors), pass the examinations of the same, and present a satisfactory thesis.

In exceptional cases candidates for the Master's degree will be allowed to study in absentia. Candidates who spend only a part of their time in study are expected to take at least two years to complete their work.

The tuition fee is $50 a year and the graduation fee is $10. No tuition fee is charged to students pursuing graduate work in non-residence, but the graduation fee is $30, and at least two years are required to complete the course.

The course of study may be selected, with the approval of the Faculty, from the following list of subjects, at least fifteen exercises per week being chosen in two departments. About two-thirds of the work is to be in one department and about one-third in another, these being called major and minor departments. The thesis is to be prepared on a subject connected with the studies of the major department. The candidate is required to satisfy each professor concerned that he is fully competent to pursue the subjects selected.

Candidates who desire to receive the Master's degree in June, 1913, are required to confer with the professors on or before September 21, 1912, and to present their courses of study to the Faculty for approval on September 23, 1912.

The following subjects are now offered by the University; other allied subjects may in some cases be selected by candidates after conference with the professors in charge.

IN MATHEMATICS AND ASTRONOMY.

Practical Astronomy.

PROFESSOR THORNBURG, ASSOCIATE PROFESSOR OGBURN.

The work embraces: (*a*) The study of instruments and methods used in the determination of time, latitude, longitude, and azimuth; (*b*) Practical work in the observatory, securing facility in making and reducing observations. Two terms (5).

Differential Equations.

PROFESSOR LAMBERT.

The course in Differential Equations is based on Johnson's Differential Equations and Byerly's Spherical Harmonics. Collateral reading in the University Library is required. Two terms (3).

Analytic Mechanics.

ASSISTANT PROFESSOR MILLER.

Elementary and Advanced Rigid Dynamics; Potential Functions, based on Love's Theoretical Mechanics; Williamson and Tarletan's Dynamics; and Routh's Dynamics. Two terms (3).

IN ENGLISH.

English Literature.

PROFESSOR THAYER.

An advanced course in branches which have not formed a part of the undergraduate work of the candidate, the details of which will be arranged after a personal conference. Two terms (5).

Anglo-Saxon.

ASSISTANT PROFESSOR MESCHTER.

Anglo-Saxon poetry and prose above the grade of undergraduate work, from both the literary and the historical point of view. Two terms (5).

Sanskrit.

PROFESSOR THAYER.

Beginners' Course. Perry's Primer. Lanman's Reader. Whitney's Grammar. Two terms (5).

IN PHYSICS.

Theoretical Physics.

PROFESSOR FRANKLIN, ASSOCIATE PROFESSOR MAC NUTT.

Elective courses are offered in the following subjects: (*a*) The Theory of Heat, based upon Preston's Theory of Heat, Buckingham's Thermodynamics, and Nernst's Theoretical Chemistry; (*b*)

The Theory of Electricity and Magnetism, based upon Maxwell's Treatise, J. J. Thompson's Recent Researches, and Conduction of Electricity Through Gases, and Hertz's Electric Waves; (*c*) The Theory of Light, based upon Preston's Theory of Light, Drude's Theory of Light, Wood's Physical Optics, and Michelson's Light Waves and Their Uses. First and second terms (3) to (5).

Physical Research.

PROFESSOR FRANKLIN.

Advanced students are given an opportunity to pursue experimental investigations in physics. First and second terms (2) to (4).

IN ECONOMICS AND HISTORY.

Political Economy.

PROFESSOR STEWART.

This course embraces: (*a*) The rise and development of economic systems and economic thought. (*b*) The scope and method of political economy. Patten's Development of English Thought and the works of Keynes, Cohn and Ingram on Political Economy will be used. Two terms (5).

American History.

PROFESSOR STEWART.

An examination of the influence of the economic development of the Union upon the legal and political theories incorporated in the Constitution. Two terms (5).

Politics.

PROFESSOR STEWART.

The history of the attempt to treat in a systematic way the problems of political organization. Pollock's History of the Science of Politics and Sidgwick's Elements of Politics. Two terms (5).

IN LATIN.

Roman Law.

PROFESSOR BLAKE.

(*a*) Roman law before Justinian; based on Bruns's Fontes Juris Romani Antiqui, and Mommsen's Abriss des römischen Staatsrechts. (*b*) Justinian's Institutes, Morey's Outlines of Roman Law, and collateral reading. Two terms (4).

Roman Philosophy.

PROFESSOR BLAKE.

(*a*) Cicero, De Legibus and De Natura Deorum; History of Roman Philosophy. (*b*) Selected readings from Seneca. Two terms (3).

Roman Literature.

PROFESSOR BLAKE.

(*a*) History of Roman literature. (*b*) Readings from Latin authors not previously read in course, as far as practicable paralleling the work in (*a*). Two terms (3).

IN GREEK.

Hellenistic Greek.

PROFESSOR GOODWIN.

Gospel of St. Mark, Acts, and selected Epistles of the New Testament. Thayer's Lexicon. Blass's Grammar of New Testament Greek. Patristic literature. Collateral reading. Selections from Lucian. Two terms (5).

Dramatic Poetry.

PROFESSOR GOODWIN.

Several plays of Aeschylus, Sophocles, Euripides, and Aristophanes. Aristotle's Poetics. Collateral reading. Two terms (5).

Greek Philosophy.

PROFESSOR GOODWIN.

Plato's Republic and other words. Aristotle, selections. Ritter and Preller's Historia Philosophiae Graecae. Zeller's History of Greek Philosophy, and other collateral reading. Two terms (5).

IN ELECTRICAL ENGINEERING.

Theory of Alternating Currents and Alternating Current Machinery.

PROFESSOR ESTY.

This course is based upon the works of Arnold, Bedell and Crehore, Steinmetz, and Franklin and Esty. Two terms (4).

Electrical Design.

PROFESSOR ESTY.

This course consists of predeterminations by calculation of the characteristics, regulation and performance of electrical machinery. Analysis and use of designing constants. Design of special machines. Two terms (3).

Electric Traction.

PROFESSOR ESTY, ASSISTANT PROFESSOR SEYFERT.

The development of an electric railway project. Design of station and distribution system. Operating characteristics of direct and alternating current railway motors. Predetermination of motor equipment and run curves for given schedules and traffic. Choice of system. Estimates of cost. Two terms (3).

Electrical Testing.

PROFESSOR ESTY, ASSISTANT PROFESSOR SEYFERT.

Special experimental research in electrical engineering; tests of the magnetic properties of iron and steel; investigation of the series single-phase alternating current motor; leakage reactance of induction motors; regulation of alternators; polyphase testing; electric railway testing. Two terms (3).

IN METALLURGY.

Thermo-Chemistry and Thermodynamics of the Metals.

PROFESSOR RICHARDS, ASSOCIATE PROFESSOR LANDIS.

A study of the melting points, boiling points, specific heats, and latent heats of fusion and of vaporization of the metals, from a practical and theoretical standpoint. Also, of the heats of formation of compounds of the metals, and the relations of these to atomic weights and other chemical and physical properties. Lectures and laboratory work. First term (5).

Thermo-Chemistry and Physics of Metallic Alloys.

PROFESSOR RICHARDS, ASSOCIATE PROFESSOR LANDIS.

A study of the physical and chemical properties of metallic alloys, their melting points, specific heats, latent heat of fusion, heats of formation and microscopic structure. Lectures and experimental work in the same. Second term (5).

Electrometallurgy.

PROFESSOR RICHARDS, ASSOCIATE PROFESSOR LANDIS.

A study of the conditions of deposition of metals and alloys in electrolysis, electrolytic separations, formation of metallic compounds of electrolysis, energy absorption in electrolysis. Lectures and laboratory work. First term (5).

IN MINING ENGINEERING.

Mining Engineering.

PROFESSOR ECKFELDT.

The study of methods used in a given mining region, or in

the production of a given class of mineral, with respect to conditions influencing choice of method and cost. Two terms (5).

Mining Plant.

PROFESSOR ECKFELDT, MR. SMITH.

The determination of the efficiency of mining machinery of given types under varying conditions. Two terms (5).

Ore Dressing Plant.

PROFESSOR ECKFELDT, MR. BARTLETT.

The study of certain operations incident to the dressing of ores or the preparation of coal. Determination of efficiency of machines and processes. Losses in dressing. Two terms (5).

IN GERMAN.

German.

PROFESSOR PALMER.

An advanced course in the German language and literature. The course will be arranged with each candidate individually upon application. Two terms (5). Also see courses 102 and 103, on page 80.

IN CHEMISTRY.

Advanced Industrial Chemistry.

PROFESSOR SCHOBER, MR. CRESSY.

This course involves the study of some industry dependent upon chemical principles and consists of experimental and analytical work in the laboratories, inspection of manufacturing establishments, and study of the technical journals and other publications. Two terms (10).

Advanced Organic Chemistry.

PROFESSOR SCHOBER, ASSOCIATE PROFESSOR BABASINIAN.

This course consists of original investigations in organic chemistry. Two terms (10).

Advanced Analytical Chemistry.

ASSOCIATE PROFESSOR ULLMANN.

Study and comparison of known methods of quantitative analysis and the development of new methods. Two terms (10).

Physical Chemistry.

DR. WILSON.

This course consists of original investigations in physical chemistry. Two terms (10).

IN GEOLOGY.

Geology.

PROFESSOR MILLER.

The investigation and study of the literature of some special geological problem. This will comprise field and laboratory work on some district in the vicinity of the University. A map of a limited area will be constructed, the microscopic character and general structural features of the rocks which are exposed will be investigated and a thesis or dissertation embodying these results will be presented. Preparation required will depend upon the nature of the problems to be studied. Two terms (4).

Economic Geology.

PROFESSOR MILLER.

Advanced work in ore deposits. Study of the literature and of the theories of ore deposition, together with detailed work on the type occurrences of some one of the metallic or non-metallic minerals. The student will be required to make a thorough investigation and report on some mining district with special regard to the origin of the ores and such commercial aspects of the deposits as may depend chiefly on the geology. Preparation required: 270 or 271. Two terms (6).

Petrography.

PROFESSOR WHERRY.

A study of the igneous and metamorphic rocks with particular reference to classification, rock nomenclature and the effects of metamorphism and the bearing of the latter upon the origin of such rocks and the metalliferous ores. Collection of suites of local rock specimens. Rosenbusch's "Mikroskopische Physiographie der petrographische wichtigen Mineralien," Michel-Lévy et Lacroix, "Les Mineraux des Roches," Zirkel's "Lehrbuch der Petrographie," Johannsen's determinative tables and Winchell's Optical Mineralogy are made use of in this course. Essentially a research laboratory and field course. Preparation required: 268, 269, 271, 272, 274, 278 and 279. Second term (3).

Physiography.

PROFESSOR MILLER.

The detailed study of physiographic types and processes. Conferences, reports and theses, with work in the laboratory and field. A training in elementary physiography (such as is given in 277) together with some knowledge of general geology is essential. Two terms (4).

Physical Crystallography.

ASSISTANT PROFESSOR WHERRY.

An advanced course in the geometrical and physical properties of crystals. Moses' Characters of Crystals, Groth's Physikalische Krystallographie. First term (4).

Chemical Crystallography.

ASSISTANT PROFESSOR WHERRY.

A discussion of the relations traceable between chemical constitution and crystalline form. Groth's Chemische Krystallographie. Second term (4).

Descriptive Mineralogy.

ASSISTANT PROFESSOR WHERRY.

An advanced study of the properties and relationships of the known mineral species. First and second terms (3).

IN CIVIL ENGINEERING.

Bridge Design.

PROFESSOR MC KIBBEN.

The theory of suspension and arched structures, with the preparation of general plans and estimates, and the economic comparison of different types. Two terms (4).

Testing of Materials.

PROFESSOR MC KIBBEN.

The properties of materials of construction, with special reference to inspection and testing. The student will conduct original researches in the laboratory. The work on the unification of methods of testing done by the International Association for Testing Materials will receive detailed attention. Two terms (5).

Railroad Engineering.

PROFESSOR WILSON.

The economic location of railroads, as influenced by probable volume of traffic and cost of operation. A course based on Wel-

lington's treatise, with the detailed discussion of special cases. Two terms (2).

Sanitary Engineering.

ASSOCIATE PROFESSOR CONKLING.

The designing of reservoirs, tanks, and pipe lines for water supply systems, and of sewers and other appurtenances for sewerage systems. Inspection of existing plants, with reports thereon. Two terms (4).

IN BIOLOGY.

Vertebrate Histogenesis and Organology.

PROFESSOR HALL.

Lectures, reading, and laboratory work. In the laboratory the development of a vertebrate will be carefuly followed, tracing the history of the germ-layers, organs, and tissues. The organology deals with the association of tissues to form organs. Preparation required: 292, 293, 294. First term (3).

IN PHILOSOPHY, PSYCHOLOGY AND EDUCATION.

Philosophy.

PROFESSOR HUGHES.

The special study of any of the following philosophers: Aristotle, Spinoza, Leibniz, Hume, Kant, Hegel, Spencer, James, and Bergson. First and second term (5).

The philosophy of religion, involving the comparison of fundamental religious attitudes as manifested in the chief religious movements of ancient and modern times. First term (3).

The philosophy of history, based on Hegel's work. Second term (3).

The history of education. A survey of past and present educational ideals and institutions, with special emphasis upon one or two selected epochs. Two terms (5).

The philosophy of education. An analysis of some important systems, ancient and modern. First and second terms (3).

IN FRENCH.

PROFESSOR FOX.

An advanced course in the French language and literature. The course will be arranged with each candidate individually upon application. Two terms (5). Also see courses 77 and 78, on page 79.

TUITION AND OTHER FEES.

For students in the courses of Civil, Mechanical, Metallurgical, Mining, Electrical, and Chemical Engineering, and Electrometallurgy, the tuition fee is $200 for the year or $120 for either term; for students in the course of Chemistry, $150 for the year or $90 for either term; for students in the courses of Arts and Science, $100 for the year or $60 for either term. The tuition rate in the course of Chemistry is lower than that of the other technical courses on account of cost of materials used in the laboratories, which are furnished to the students at wholesale prices. The tuition for the subjects offered in the Summer term immediately following Commencement Day is $20. No charge is made for such subjects to students who have paid tuition for the previous year, provided the subjects in question are a scheduled part of the technical courses they are pursuing. A graduation fee of $10 is paid by all candidates for a degree. A registration fee of $10 is paid by each student yearly when he enrolls. $7 of this is paid to the Athletic Association and entitles the student to admission to all athletic contests held at the University; $3 is applied to the maintenance of Drown Memorial Hall, a building devoted to the convenience and pleasure of the student-body (see page 135). This registration fee was imposed at the request of the student-body.

The tuition fees are payable to the Bursar of the University in two instalments, on the opening day of the college year in September, and on the first day of the second term in February. The first instalment is $120, $90, or $60, according to the course, and the second $80, $60, or $40. Application may be made for a return of part of the tuition fee when a student has formally withdrawn from the University after less than four weeks' attendance in either term, but the amount thus refunded will in no case exceed one-half of the last instalment paid.

Students who fail to pay tuition fees when due will be notified that their attendance at college exercises must be discontinued until payment is made.

EXPENSES.

Books, stationery, and drawing instruments are provided by the students, and can be obtained at the students' supply bureau in Drown Memorial Hall. Materials consumed in the laboratories can be obtained from the University, their value being covered by a deposit made at the opening of that term in which the laboratory work is to be done. These deposits for the various labora-

tories are given under the detailed statement of laboratory courses in the List of Studies.

Rooms and board may readily be obtained in many private houses in South Bethlehem and Bethlehem. 140 students are domiciled in Taylor Hall. Any desiring to do so may obtain table board at the College Commons at $15 for thirty consecutive days, or $4 for a single week.

Necessary expenses for the collegiate year, clothing and traveling not included, are estimated at $300 to $400 in addition to tuition. This includes attendance at the required Summer schools.

SITE.

South Bethlehem is situated at the junction of the Lehigh Valley, the New Jersey Central, and the Philadelphia and Reading Railroads, and the University buildings are about a half-mile from the station. New York is eighty-six and Philadelphia fifty-seven miles distant.

The situation of the institution is healthful and beautiful. The region is famous for its mines and its railway and manufacturing enterprises.

BUILDINGS.

PACKER HALL.

This building, completed in 1869, is four stories in height, 215 feet long, and 60 feet wide. It is built of Potsdam sandstone in the English Gothic style of architecture, and occupies a commanding position, overlooking Bethlehem and South Bethlehem.

The department of Civil Engineering occupies the greater part of the first and second floors of Packer Hall. On the first floor are a lecture room, two recitation rooms, a large drawing hall, two instrument rooms, two offices and a library room, and a shop equipped with a small lathe and other tools for use in repairing surveying instruments. The instrument rooms contain seventeen transits, fourteen levels, a large geodetic theodolite, two plane tables, and other instruments for engineering field work. In the library room is an excellent collection of plans of engineering structures. On the second floor are two drawing rooms, three recitation rooms, an instrument room, a blue-print room, and offices.

On the third and fourth floors are to be found the offices and recitation rooms of the department of Mathematics and Astronomy.

THE CHEMICAL AND METALLURGICAL LABORATORIES.

This is a thoroughly fire-proof building, built of sandstone, 219 feet in length by 44 in width, with a wing.

In the Chemical department there are two principal stories and a basement. The upper floor is occupied by the quantitative and the qualitative chemical laboratories. These rooms are 22 feet in height, and are well lighted and ventilated. Laboratories for industrial chemistry and the supply room are also on this floor.

The first floor contains a large lecture room, a smaller lecture room, a recitation room, a chemical museum, and laboratories for organic, physical, and sanitary chemistry.

In the basement is a large laboratory for the furnace assay of ores and a well appointed laboratory for gas analysis; also rooms containing the apparatus for several processes in industrial chemistry, the engine and air pump for vacuum filtration, etc.

The Metallurgical department contains a lecture room, a blowpipe laboratory for class instruction in blowpipe analysis; a museum of metallurgical collections; a laboratory provided with Goldschmidt's "two-circle" reflecting and application goniometers, a polariscope, a Groth's "universal apparat," a simple and a polarizing microscope, two Le Chatelier microscopes complete with cameras; a dry laboratory provided with furnaces for solid fuel and for gas, with natural draught and with blast, electric current for electrometallurgical experiments, and a wet laboratory for ordinary analytical work. Equipment has recently been provided for laboratory work in metallurgy, in metallography, and particularly in electrometallurgy, consisting of working places for students, each equipped with gas, electric current, and apparatus for various kinds of experimental work; and several new pyrometers, calorimeters, and furnaces have been added to the general equipment. These departments are therefore well arranged and equipped for the instruction of classes in the courses of metallurgy, electrometallurgy, and blowpipe analysis of the regular curriculum, and to afford facilities to students for familiarizing themselves with the methods of measurement and research employed in metallurgy and electrometallurgy, and for conducting original investigations in these departments of science.

The department of Economics and History is located in this building.

THE PHYSICAL AND ELECTRICAL ENGINEERING LABORATORY.

This building is 240 feet long, 44 to 56 feet wide, and four stories high. The halls and stairways, the photometer rooms, and all apparatus rooms are of fire-proof construction. The remainder of the building is of heavy mill construction.

On the first floor are the Advanced Electrical Laboratory and shops of the Physics department, the Senior and Junior dynamo laboratories, the shops, and research room of the Electrical Engineering department, and a storage battery room belonging jointly to the departments of Physics and Electrical Engineering.

The dynamo laboratory for Senior students in the west wing is supplied with power from a 75-kilowatt rotary converter receiving current from the University power plant through two 30-kilowatt transformers. The dynamo laboratory equipment, which is being constantly increased, now includes the following apparatus: an 18-kilowatt double current generator, two direct current motor-generator units, one Lincoln variable speed motor, a 4-kilowatt Westinghouse two-phase rotary converter, a 10-kilowatt General Electric six-phase compound rotary converter, two direct connected units consisting of 7½-kilowatt six-phase General Electric alternators driven by 15-horse power Allis-Chalmers motors, one 20-kilowatt two- (or three-) phase alternator built by the Department, a 35-kilowatt Westinghouse single-phase alternator, a 10-kilowatt composite wound alternator driven by a 15-horse power Crocker-Wheeler motor, a pair of 3-horse power direct connected series crane motors, three motor-generator sets converting from alternating to direct current, four induction motors ranging from 7½-horse power to 2-horse power, twenty-two transformers of from 1 to 15 kilowatts, including two 15-kilowatt Scott-connected transformers, a 6-light constant current transformer, a 30-ampere arc rectifier outfit complete, and a variety of instruments including voltmeters, ammeters, watt-meters, rheostats, contact makers, frequency meters, dynamometers, condensers, and other apparatus.

The dynamo laboratory for Junior students on the first floor in the west wing contains the following apparatus: a 20-kilowatt Ferranti alternator driven by a direct current motor, two arc light machines, twenty arc lamps of various types, a Brackett cradle dynamometer, a Westinghouse two-phase rotary converter, a motor driven battery-booster set, and other motors for direct and alternating currents.

On the second floor are the offices of the departments of Physics and of Electrical Engineering, two general apparatus rooms, a large laboratory room for Physics, a large dynamo laboratory for Sophomore students in Electrical Engineering, and an Electrical Engineering reading room. The dynamo laboratory for Sophomore students in the west wing is equipped with twenty-seven direct current machines of various types.

On the third floor are the lecture room, apparatus rooms and photometer rooms of the department of Physics, and lecture room, recitation rooms, apparatus room, and drafting room of the department of Electrical Engineering.

On the fourth floor are recitation rooms and two large laboratory rooms of the department of Physics. A large room for Freehand Drawing is located on this floor.

THE W. A. WILBUR ENGINEERING LABORATORY AND POWER HOUSE.

The laboratory portion of this building was erected in 1902; in 1907 the original building was doubled in size, the addition containing the new heating and lighting plant of the University. The building is of sandstone, conforming in material to the adjacent Chemical and Physical Laboratories. It is 44 feet wide by 188 feet long, one story high in the boiler room, but with a raised engine room forming a second story at either end.

The boiler equipment of the laboratory consists of two water-tube boilers rated at about 100-horse power each, one of Babcock & Wilcox type, the other of Stirling make. In the heat and light plant there are three 250-horse power Stirling boilers, with room for a fourth unit of equal or greater capacity. Each section has its own set of feed pumps and other auxiliaries, in the arrangement of which special provision has been made for easily conducting performance tests. The laboratory boilers are connected to the chimney of the old boiler house, and have also an induced draft outfit. The chimney of the newer plant is of radial brick construction, 125 feet high, and a forced draft equipment is to be installed when need for increased capacity arises.

A coal-storage yard north of the building has room for a season's supply of coal, and a system of belt-conveyors and bucket-elevator is provided for receiving coal, dumping it on storage pile, and conveying it into the boiler room as needed.

The engine room of the laboratory, 50 feet long, contains a vertical triple-expansion engine of 75-horse power, a 60-horse power compound two stage Ingersoll air compressor, a small tandem-compound yacht engine, a simple Ball engine direct connected to a 25-kilowatt Crocker-Wheeler generator, and a 5-horse power De Laval steam turbine. There is also a complete set of Westinghouse air-brake apparatus, with four freight car brakes. The air-brake pump and all the other steam motors, including the feed and condenser pumps, are piped to the surface condensers beneath the engine room floor. There are two large condensers of 150 and 60-horse power capacity respectively, with smaller ones for the pumps and for special experiments. Besides the various engines there is a large belt dynamometer, apparatus for testing gauges, indicators, thermometers, steam calorimeters and other instruments, and for experiment on flow of steam, for testing injectors, etc. The exhaust system includes a Cochrane feed-water heater of 250-horse power capacity.

The engine room of the power house is 31 feet long, with concrete floor. The generating units now installed are of 50 and 100-kilowatt rating, and there is room for a third of larger size. Simple horizontal Ball engines are direct connected to General Electric alternating current generators, which furnish 60-cycle two-phase current at 2200 volts for transmission to the various distributing centers. An engine-driven and a motor-driven exciter, with the switchboard, complete the electrical equipment. The engines exhaust through a Cochrane heater, and the exhaust steam is discharged directly into the low-pressure system during the heating season.

The abandonment and dismantling of the old boiler plant rendered available for laboratory use a floor space 45 feet by 70 feet in the old boiler house. This is used for apparatus and experiment in gas-power engineering and hydraulics, and for a number of the minor thermodynamic experiments with steam.

This building bears the name of W. A. Wilbur in grateful recognition of the work he has done for Lehigh University.

WILLIAMS HALL.

This building was the donation of Prof. Edward H. Williams, jr., of the Class of '75, and was so named by the Trustees of the University not only in recognition of this gift but also of Prof. Williams' long continued and important services to the University as an Alumnus and as Professor of Mining and Geology.

Williams Hall is 186 feet long by 70 feet wide and covers a ground area of over 12,000 square feet. One-half of the building is devoted to the department of Mechanical Engineering and the other half to Geology and Biology.

In the eastern end are located the recitation rooms, instructors' offices, drawing rooms, reference library, and store rooms of the department of Mechanical Engineering, and in the basement rooms and apparatus are provided for laboratory work in experimental mechanics and engineering physics, such as the calibration of the measuring instruments used in Mechanical Engineering, the determination of the mechanical efficiencies of hoisting and other gear, and the testing of motors. In this section there are electric motors, a water motor, a 15-horse power centrifugal pump, hoists, blocks, jacks, and dynamometers of various kinds.

In the west end the department of Geology has on the first floor two lecture rooms, two offices, library, mineralogical museum, and laboratory of petrology, and on the second floor a laboratory of petrography. The lecture rooms contain specimens of rocks and fossils and a collection of economic minerals and ores. The main lecture room is fitted with a stereopticon for illustrated lectures. The laboratory of petrography is provided with fifteen high-grade petrographic microscopes, and study collections of rocks and minerals. The collection of rocks contains over five thousand specimens collected from the type regions in different parts of the world. The mineralogical museum contains many valuable collections representing all the prominent mineral localities of the world. In the basement are the mineralogical laboratory, a small chemical laboratory for analytical work, and a room fitted with apparatus run by a one-horse power motor for cutting thin sections of rocks. On the first floor is the paleontological laboratory, which contains the fossil collections. On the third floor is a room devoted to the use of students pursuing advanced work in geology.

A large room in the well-lighted basement is used by the department of Mining Engineering for illustrative material and contains a large size and a small size Ingersoll-Rand Rock Drill, an Ingersoll-Rand Pick Machine for coal mining, a Water-Leyner Rock Drill, a Sullivan hand-power diamond drilling machine, a Temple-Ingersoll electric-air drill, a Phillips Automatic Crossover Car Dump with a full-sized mine car, and several

sets of steel mine timbers. A pipe line carries compressed air from the Steam Engineering Laboratory for operating the rock drills. On the third floor are located the drawing room and an office of the Mining department, also well-equipped blue-print and dark rooms and a photographic laboratory used jointly by the Departments of Mining and Geology.

The Department of Biology has its lecture room, office, reference library, laboratories, and store rooms on the second floor, and a large vivarium on the third floor. The laboratories of this department are thoroughly equipped with collections, sections, microscopes, and necessary appliances.

Two students' rooms, used by the Mining and Geological Society and by the Mechanical Engineering Society, are located in the basement.

THE FRITZ ENGINEERING LABORATORY.

Realizing the great need of an adequate laboratory for the testing of materials, the eminent engineer, Mr. John Fritz, of Bethlehem, known as the father of the steel industry in the United States, and a member of the Board of Trustees dating from the founding of the University, recently donated to the University the funds for the erection and thorough equipment of an engineering laboratory. The building was designed and erected under the personal supervision of Mr. Fritz. It has been named by the Trustees "The Fritz Engineering Laboratory." The building is equipped with a general testing section for testing iron and steel, a cement and concrete section, and a hydraulic section. The equipment is used by the Civil Engineering Department in connection with courses in Strength of Materials, Hydraulics, and Cement. Any student in the University who has the proper preparation may receive instruction in this laboratory.

The building is of modern steel frame construction, 94 feet wide and 115 feet long, with the main central section 65 feet in height, and two side sections of lesser height. The external walls which enclose the steel frame are of cement brick lined on the inside with red brick. A traveling crane, operated by electricity and of 10 tons capacity, commands the entire central portion of the building in which the testing of large specimens is carried on.

The general testing section is equipped with an 800,000-pound Riehlé vertical screw testing machine, capable of testing columns 25 feet long or less, tensile specimens 20 feet long or less, and transverse specimens up to lengths of 30 feet; an Olsen universal

testing machine of 300,000 pounds capacity; smaller machines for ordinary tension, compression, transverse and torsion tests; a cold-bend testing machine, and a small machine shop. The hydraulic section occupies the east end of the main room and is equipped with various tanks, weirs, pumps and other apparatus for studying problems in Hydraulics. The cement and concrete section has one large room for the making and testing of specimens and one room for the storage of materials.

THE ECKLEY B. COXE MINING LABORATORY.

This building is situated south of Williams Hall and is of dressed sandstone. It is 100 feet long by 75 feet deep, one story high in the front with a raised floor in the rear.

The main part of the building contains the Ore Dressing Laboratory, 40 feet by 70 feet; the west wing contains a chemical laboratory, an assay room, a balance room, and a laboratory for testing samples; the east wing contains the office, recitation room and an instrument room. A locker and wash room is located in the basement of the east wing.

The equipment for the main laboratory, made by the Allis-Chalmers Co., consists of a gyratory crusher, rolls, screens, jigs, Huntington mill, classifiers, concentrators (table and vanner), gravity stamps, amalgamating plates, grinding pan, and cyanide plant, with the necessary apparatus including grizzly, elevators, feeders, sand-pumps, settling tanks, zinc boxes, filter press, dryers, crawls, blocks, and electric motors. The laboratory for testing samples contains a work table for the students, also a small jaw crusher, rolls, sample grinder, and a magnetic separator.

The above machinery is driven by six separate motors, and any one part or all of it can be operated at will, thus enabling experimental studies and tests to be made of individual machines or groups of machines, or of an entire process, as occasion may require. A round thirty-six inch water-jacketed smelting furnace is located outside of the building.

In this way the entire plant is made flexible and enables combinations of processes in order to determine the best possible method to pursue in the treatment of gold and silver ores, both free milling and sulphides, by amalgamation and cyanide processes, and of lead, copper, zinc, iron ores, etc., and of coals, by coarse and fine concentration.

This laboratory has been named by the Trustees of the University "The Eckley B. Coxe Mining Laboratory" in memory of one

who was universally recognized as a pioneer and a leader in the profession of Mining Engineering in this country and who was an active friend and valued Trustee of the University from its early days until his death. It is highly fitting that the Engineering and Mining Laboratories of Lehigh University should bear the names of John Fritz and Eckley B. Coxe, and that the record of the friendship and close association of these two great engineers in their life-time, and their active interest in Lehigh, should be perpetuated by these buildings bearing their names.

SAUCON HALL.

Extensive alterations to this building were made in 1896, adapting it to the needs of the department of English. It contains a study and a recitation room for each instructor, a lecture hall seating 200 persons, and a large room on the ground floor which has been fitted up for the use of the literary societies, with committee rooms adjoining.

CHRISTMAS HALL.

This building (the oldest in service of all the University's plant, being the first erected on the campus) is devoted to the departments of Greek, Latin, German and Romance Languages and of Philosophy, Psychology and Education. On the ground floor are the offices, departmental library and recitation rooms of the departments of German and Romance Languages. The offices and recitation rooms of the departments of Greek and Latin are on the second floor.

Psychological Laboratory and Practice School. The Psychological laboratory is situated on the third floor of this building. It is equipped for elementary instruction and experimentation in the psychology of sense and movement. Opportunities for brain dissection are provided.

The practice school meets in this building. It is attended by young men of the vicinity, who seek instruction in grammar and high school subjects. It is taught by students in Education, under the supervision of the instructor.

SAYRE OBSERVATORY.

By the liberality of the late Robert H. Sayre, Esq., one of the Trustees of the University, an Astronomical Observatory was erected on the University grounds, and placed under the charge of the Professor of Mathematics and Astronomy.

The Observatory contains an Equatorial Telescope, by Alvin Clark, of six inches clear aperture and of eight feet focus; a

Zenith Telescope, by Blunt; a Superior Astronomical Clock, by William Bond & Sons; a Meridian Circle; a Prismatic Sextant, by Pistor and Martins; and an Engineer's Transit and a Sextant, by Buff and Buff.

Students in practical astronomy receive instruction in the use of the instruments and in actual observation.

The land upon which the Observatory stands, consisting of seven acres adjoining the original grant, was presented to the University by the late Charles Brodhead, Esq., of Bethlehem.

Sayre Observatory Annex.

This building contains a modern zenith telescope of four and one-half inches clear aperture equipped with electric illumination. The building and instruments were presented to the University by the late Robert H. Sayre, Esq., July 23, 1903.

Observations secured with this instrument are for the purpose of investigating the Variation of Latitude.

THE PACKER MEMORIAL CHURCH.

The Packer Memorial Church, in which daily chapel exercises are held, was the munificent gift of Mrs. Mary Packer Cummings, daughter of the Founder of the University. It was built in 1887 and is one of the largest churches in the State. During 1909-10 it was thoroughly renovated; the walls were newly frescoed, new stained glass windows put in place, and electric lights installed. These improvements were made possible by the continued generosity of the donor, Mrs. Cummings.

THE UNIVERSITY LIBRARY.

The Library building was erected by the Founder of the University in 1877, at a cost of $100,000, as a memorial of his daughter, Mrs. Lucy Packer Linderman.

The building is semi-circular in plan, with a handsome façade in the Venetian style of architecture. It is constructed of Potsdam sandstone with granite ornamentation. In the interior the center is occupied by a reading space, 40 by 50 feet, from which radiate the book cases, extending from floor to ceiling; two galleries affording access to the upper cases. Shelf room is now provided for one hundred and sixty thousand volumes. The building is thoroughly fire-proof, well lighted, and heated by steam.

One hundred and twenty-three thousand volumes are now upon the shelves, including many extremely valuable books. The list of periodicals numbers about four hundred, embracing as far as possible all departments of knowledge.

The Library is open from 8 A.M. to 6 P.M., except Sundays and holidays.

The free use of the Library, with the privilege of taking out books, is offered to students of every department on presentation of their registration cards. The use of the books and of the periodicals within the building is free to all persons. Resident graduates of the University have the full use of the Library on payment of three dollars annually. Any person, pursuing systematic investigation in any study, may be allowed the full use of the Library for a period not exceeding three months without fee. At the discretion of the Director, a deposit may be required when books are issued.

The Eckley B. Coxe Memorial Library.

In memory of the Hon. Eckley B. Coxe, who was for many years a Trustee of the University and who was profoundly interested in its welfare, Mrs. Coxe presented to the University his technical library, consisting of 7727 volumes, together with 3429 pamphlets. As the working library of a man who was remarkable as well for the breadth of his culture as for the extent and thoroughness of his acquaintance with the whole field of applied science, this addition to the resources of the University possesses the greatest value for all professional students.

GYMNASIUM.

The University Gymnasium is equipped with modern appliances for recreative and corrective exercises. It is furnished with apparatus for calisthenic and heavy gymnastics, both for individual and for class work, basket-ball and hand-ball courts and running track, hot and cold shower baths, and lockers.

TAYLOR HALL.

The dormitory, the gift of Mr. Andrew Carnegie, is a commodious concrete structure situated in the University Park, south of Packer Hall, and contains rooms suitable for the accommodation of about 140 students with suites of three rooms, a study and two adjacent bed rooms, for two occupants, and a few single rooms. The building was named Taylor Hall by Mr. Carnegie in honor of Charles L. Taylor, his former partner in business, a graduate of the University in the Class of '76 and a Trustee of the University. The rates for the suites of rooms are $81 a year for each occupant. The single rooms are $65 a year.

Applications for rooms in Taylor Hall should be filed with the Bursar.

Another building, located south of Williams Hall, is being remodeled and will be available in September, 1912, as a dormitory for 34 students. Some of the rooms are single, and others in suites.

Application for rooms should be filed with the Bursar.

DROWN MEMORIAL HALL.

This building, erected by his friends and the alumni of the University as a memorial to the late Thomas Messinger Drown, LL.D., President of the University from 1895 to 1904, is devoted to the social interests of the University students. It contains study, reading, conversation, and chess rooms, an assembly hall, and the offices of the Alumni Association, the Young Men's Christian Association, the Athletic Committee, the College Publications, the Dramatic and Musical Organizations. It also accommodates the Supply Bureau, conducted by the University, the purpose of which is to furnish books, stationery and supplies to the students at reasonable prices. The profits of the Supply Bureau are applied to the upkeep of Drown Memorial Hall.

THE COLLEGE COMMONS.

The Commons was erected in 1907 to furnish a place where students might obtain wholesome food at cost. There are accommodations for four hundred students. The rates for table board are $15 for thirty consecutive days, or $4 for a single week.

ATHLETIC FIELD.

An Athletic Field is provided by the University for the accommodation of students who wish to participate in the various outdoor sports. Foot-ball, base-ball, and lacrosse fields are provided, also a quarter mile running track. Bleachers and grandstands furnish seating capacity for about 7000 spectators.

A Field House, fitted with 80 steel lockers and 10 hot and cold water shower baths, furnishes accommodations for the various athletic teams.

A Cage with 60 by 120 feet floor space is provided for indoor base-ball, lacrosse, and track and field sports practice.

All athletic sports are under the direction and oversight of the Professor of Physical Education, who is aided by an Athletic Committee composed of Alumni and students, members of the Faculty, a member of the Board of Trustees, and the President of the University.

SAYRE PARK.

This development of the mountain side of the University grounds was effected through the donation to the University in 1909 of the sum of $100,000 by the children of the late Robert H. Sayre to be applied and used in the development of Sayre Park as a memorial to their father. Mr. Sayre was a Trustee of the University from its foundation in 1866 to his death in 1907. He acted for years as the Chairman of the Executive Committee of the Board of Trustees, and his services to Lehigh were so constant and great that during his lifetime he unquestionably led the friends of the Institution in the promotion of the University's interests. It is a matter of great satisfaction to the Alumni of the University that his name should be enshrined in this beautiful park on South Mountain.

THE ARBORETUM.

The Arboretum, a tract of about six acres added in 1909 to the upper end of Sayre Park, was established as a tree nursery for the purpose of furnishing illustrative specimens of our American trees, and of cultivating trees and shrubs for the beautifying of the Park. All of the more important species of North American trees are to be found in the University Park and the Arboretum.

DIPLOMAS AND CERTIFICATES.

The Diploma is given only to those who have passed all the examinations in a regular course. For all the partial courses a certificate is given, signed by the Secretary of the Faculty, and showing what the student has accomplished.

THE UNIVERSITY MUSEUMS.

The University Museums include large collections illustrating various branches of Chemistry, Metallurgy, Geology, Mineralogy, Zoölogy and Archæology.

The Metallurgical Cabinet includes specimens illustrating the various processes for obtaining the more common metals.

The Zoölogical collections include the Packer collection of recent shells and the Werner collection of American birds. The latter contains over three hundred and fifty species. In most cases, in addition to the adults, specimens in different plumages as well as the nests and eggs are represented.

The Geological and Mineralogical Museums are located in the west end of Williams Hall, and contain the Roepper and Keim mineral collections, collections of fossils, specimens of ore from

mining districts, and extensive series of rocks which illustrate the type occurrences in different parts of the world.

The Cummings Archæological Cabinet has three thousand specimens and includes Dr. Stubb's collection of Indian relics, weapons, and utensils.

UNIVERSITY LECTURES.

From time to time during the University year, distinguished men are invited to lecture before the students upon those special subjects to which they have given particular attention and upon which they are authorities.

The following lectures have been given in this course during the years 1910-1911 and 1911-1912.

Mr. Henry J. Hadfield, "Kipling."

Dr. Harvey W. Wiley, "The National Health, the Greatest of Our Natural Resources."

Dr. J. T. Rothrock, "Recent Developments in Forestry."

Dr. N. C. Schaeffer, "Has the School Heard the Voice of Conservation?"

Prof. William Kent, "Engineering and Common Sense."

Hon. Curtis Guild, jr., "Our Neglect of the Trees."

Prof. Joseph W. Richards, "A Trip to Panama."

Mr. W. L. Saunders, "The Right and Strength of Equal Suffrage."

Mr. G. O. Shields, "Wild Animals and Birds."

Mr. Fullerton L. Waldo, "From the Rio Grande to Panama."

Prof. Filibert Roth, "European and American Conditions in Forestry."

Mr. George H. Maxwell, "Save the Forests and Store the Floods."

Mr. Samuel N. Spring, "Forestry in Connecticut."

Mr. James A. Watson, "Patents."

Mr. E. A. Ziegler, "The Financial Aspects of Forestry."

Mr. Herbert N. Casson, "The Wonders of the Telephone System."

The Rev. Paul de Schweinitz, "The Oberammergau Passion Play of 1910."

Prof. Henry F. Hornbostel, "Pre-Historic Ruins of Yucatan."

Dr. William J. Holland, "Recent Paleontological Discoveries by the Carnegie Institute of Pittsburgh."

Prof. B. E. Fernow, "Personal Reminiscences of the Earlier Forestry Movement in the United States."

Mr. H. S. Graves, "Progress in Forestry."

Dr. Harvey W. Wiley, "Public Health."

Prof. J. McKeen Cattell, "Science and Democracy."

Mr. Charles Day, "The Planning and Building of Industrial Plants."

THE CHEMICAL SOCIETY.

This Society was organized in the fall of 1871.

The collections of botanical and zoölogical specimens belonging to the Society are important. During the past years persons have been sent to Texas and Brazil to collect specimens for these cabinets.

THE ENGINEERING SOCIETIES.

The original Engineering Society was organized in 1873 and was open to all technical students of the University. From 1885 to 1890 it issued quarterly five volumes of "The Journal of the Engineering Society of Lehigh University," containing contributions by the members, alumni, and others. Many of the papers read before this Society from 1890 to 1893 were published in "The Lehigh Quarterly."

In 1900 the Civil Engineering and Mechanical Engineering students formed independent societies. The Electrical Engineering Society, founded in 1887, was reorganized in 1901. Later the Metallurgical Society and the Mining and Geological Society were formed. All these Societies hold monthly meetings for the reading and discussion of papers relating to the subjects of their particular departments.

THE ARTS AND SCIENCE CLUB.

This society was organized in the fall of 1905. Its object is to supplement the routine class-room work of the course in Arts and Science by the reading and discussion of papers on topics of varied interest. Discussions are led from time to time by members of the Faculty and addresses are made by scholars from outside the University. Students in all the courses of the University are eligible for membership.

THE CHINESE CLUB OF LEHIGH UNIVERSITY.

This society was organized in November, 1909, by the Chinese students of the University for literary purposes and the mutual aid of its members.

THE Y. M. C. A. OF THE UNIVERSITY.

This is a voluntary organization of the students for the promotion of the religious, moral, and social life of the University. It was organized April 18, 1890, and on October 11, 1890, united itself with the Intercollegiate Young Men's Christian Association. The movement is distinctly for and by students, all the officers, with the exception of the General Secretary, a college graduate, being chosen from the student-body.

FOUNDER'S DAY.

On the first Saturday of October of each year, Commemorative Exercises are held in honor of the Founder of the University. On Saturday, October 7, 1911, the thirty-second Founder's Day was celebrated. An address was delivered by James McCrea, Esq., of Philadelphia, President of the Pennsylvania Railroad Company.

PUBLIC WORSHIP.

Morning prayers are held in the Packer Memorial Church of the University, at which attendance is required.

UNIVERSITY SERMON.

This sermon is preached on the Sunday before University Day. The Rt. Rev. Charles David Williams, D.D., LL.D., Bishop of Michigan, was the preacher on Sunday, June 11, 1911, in the Packer Memorial Church.

HONOR SYSTEM.

The Honor System is in force at Lehigh University, having been adopted by the unanimous action of the student-body.

GRADUATING THESES.

Every student is required to present a thesis upon some topic connected with the course from which he is to graduate, as a necessary portion of the exercises for his final examination for a degree. These theses are accompanied by drawings and diagrams, whenever the subjects need such illustration. The originals are kept by the University, as a part of the student's record, for future reference, but a copy may be retained by the student, and be published, permission being first obtained from the Faculty.

Theses on the following subjects were prepared by candidates for degrees in 1911.

FOR THE DEGREE OF MASTER OF SCIENCE.

ALFRED COPELAND CALLEN, E.M. (*Lehigh University*), South Bethlehem.
Geological Survey of the Emaus Region of the Allentown, Pa., Quadrangle.

CHESTER ARTHUR PIERLE, A.B. (*De Pauw University*), South Bethlehem.
The Phase Relations of the System Sodium Meta-Vanadate and Water.

FOR THE DEGREE OF BACHELOR OF ARTS.

CARL WILLIAM HASEK, Franklin.
The Theban Legend in the Greek Tragedians.

HORACE DONALD KERR, Titusville.
Newton, the Founder of Modern Science.

ARCHIBALD ROBERT SHAW, New York, N. Y.
Forgotten Worthies of the Knickerbocker School.

FOR THE DEGREE OF CIVIL ENGINEER.

JOAQUIM GREGORIANO DE ANDRADE, M.E. (*Lehigh University*),
Design for a Steel Viaduct. Manáos, Brazil.

JOHN LOUIS BECKER, Newark, N. J.
A Study of the Design and Construction of Concrete Forms.

JOHN MUSGRAVE BLEY, Narberth.
A Survey of a Portion of the Lehigh River.

FRANK SPAULDING BORDEN, Tunkhannock.
A Survey of a Portion of the Lehigh River.

WALTER CORNELIUS CARSON, Philadelphia.
Experimental Determination of Adhesion between Steel and Concrete.

CARLTON HART CHAPIN, Brooklyn, N. Y.
Design for a Reinforced Concrete Arch Bridge at New Street, Bethlehem, Pa.

WILLIAM HOWARD CORDDRY, A.B. (*Washington College*), Snow Hill, Md.
Comparison between Two Designs for an Arch Bridge at Los Angeles, Cal.

COLUMBUS JOSEPH HELLEN, Baltimore, Md.
Experimental Determination of the Shearing Strength of Railroad Spikes.

ALBERT KELLER HOHL, Philadelphia.
Experimental Determination of the Strength of Reinforced Concrete Columns.

DANIEL HORCASITAS, JR., Chihuahua, Mexico.
A Study of the Different Types of Dams.

HENG TSING HU, Soochow, China.
Design for a Reinforced Concrete Arch Railroad Bridge.

ALDRIDGE ELLIS HUNT, Stroudsburg.
Experimental Determination of the Strength of Reinforced Concrete Columns.

CLIFFORD FRANKLIN LINCOLN, Philadelphia.
Railroad Signals.

WILLIAM HENRY MOHR, Quakertown.
Experimental Determination of the Strength of Reinforced Concrete Columns.

FRANZ EDWARD RASMERS, Baltimore, Md.
A Survey of a Portion of the Lehigh River.

LEWIS RINEHART PFOUTZ REESE, Gwynnbrook, Md.
Measurement of Flow in the Lehigh River.

HENRY REIMERS, New Brighton, N. Y.
Experimental Determination of the Strength of Reinforced Concrete Columns.

GEORGE HENRY REUSSNER, South Bethlehem.
Measurement of Flow in the Lehigh River.

GERALD STAATS RINEHART, New York, N. Y.
Experimental Determination of Adhesion between Steel and Concrete.

OTHELLO HENRY SCHROEDL, Baltimore, Md.
Electrolysis of Steel Imbedded in Concrete.

CHESLEY COVINGTON THORNBURG, South Bethlehem.
Determination of the Longitude of Sayre Observatory, South Bethlehem, Pa.

MANUEL LUCAS VICENTE, San Juan, P. R.
Determination of the Longitude of Sayre Observatory, South Bethlehem, Pa.

ROBERT FARMER WOOD, Pottsville.
Experimental Determination of the Strength of Reinforced Concrete Columns.

LUTHER CHASE WRIGHT, Baltimore, Md.
Experimental Determination of the Strength of Reinforced Concrete Columns.

FOR THE DEGREE OF MECHANICAL ENGINEER.

EDGAR FOSTER BAUMGARTNER, Asbury Park, N. J.
The Effect of Heat Treatment and Processes of Working on the Structure of an Alloy Steel: C .26, Mn .48, Cr .92, Va .20.

GROVER BUTZ, Schuylkill Haven.
Boiler and Engine Test of Dobbins Hosiery Mill, South Bethlehem, Pa.

ELMER MACDOWELL CONOVER, Lambertville, N. J.
Oxy-Acetylene Flame and its Use in Autogenous Welding.

GEORGE CORBETT CRAVER, Binghamton, N. Y.
Determination of Latent Heat of Vaporization of Gasoline, Kerosene, and Distillates.

RAYMOND FLOYD CRUMP, Pittsburgh.
The Effect on Carbon Steel of Heat Treatment and of Various Working Processes.

THOMAS RUSSELL DAVIES (with O. L. J. Graham), Montrose.
Test of Gas Engine and Producer Plant for General Efficiency and Fuel Consumption.

HARRY ADAMS DUNSTAN, Carbondale.
Test and Study of Merrick Weightometer.

NELSON JAMES EWING, Wheeling W. Va.
Test of Three Corliss Rolling Mill Engines at the Whitaker Mill of the Whitaker-Glessner Company, Wheeling, W. Va.

OSCAR LAWRENCE JACKSON GRAHAM (with T. R. Davies), New Castle.
Test of Gas Engine and Producer Plant for General Efficiency and Fuel Consumption.

HARRY ALTER HAAS, Tamaqua.
Efficiency Test of the Heating and Power Plant at Mount Hermon School, Mass.

GEORGE RICHEY HORNER, Allegheny.
An Investigation into the Physical Behavior of Alloy Steels under Heat Treatment.

DANIEL CHARLES KEEFE, South Bethlehem.
Oxhydric Process of Cutting Metals.

CHARLES KOCH, Philadelphia.
Test of Corliss Engine with Berry Boilers of Baugh & Sons Chemical Company.

DONALD RANDOLPH LOWRY, Berwick.
Comparative Tests of Portable Pneumatic and Electric Drills.

WALTER LEROY MERKEL, Reading.
Test of a Power Plant.

EARL LAMONT MORGAN, Bethlehem.
Test of Engines and Boilers at Uhl's Brewery, Bethlehem, Pa.

HERBERT THICKINS QUIN, Wilkes-Barre.
Degradation of Coal.

WALTER GOTTLIEB SCHALL, South Bethlehem.
Power Test of Lloyd Silk Mill, Lehigh Valley Silk Mills, South Bethlehem, Pa.

CHRISTIAN ALLEN SCHWARZWAELDER, Brooklyn, N. Y.
Test of Power Plant of Weilbach Silk Mill, Allentown, Pa.

JOHN HAMPTON SLATE, Williamsport.
Examination of Failure of Steel Rail by Metallographic Method.

OLIVER HOBSON SMITH, Pottstown.
Test of Hydro-Electric Plant.

JOSÉ IGNACIO VELA, Ambato, Ecuador.
Test of Boiler, Engine and Refrigerating Machine of the South Bethlehem Brewing Company.

FOR THE DEGREE OF ENGINEER OF MINES.

CHARLES WILLIAM RAUCH, Bethlehem.
The Oxford Furnace, N. J., Iron Mines.

LOUIS ALLGAIER REHFUSS, Philadelphia.
Proposed Plans for the Development of a Mexican Mine.

JAMES HUMBLE SMITH, JR., Mount Carmel.
Development of Bituminous Coal Property in Kanawha County, West Virginia.

LEON WITTGENSTEIN, Louisville, Ky.
Magnetic Ore Concentration.

GEORGE REID WOOD, Pottsville.
The Cyanide Process.

FOR THE DEGREE OF METALLURGICAL ENGINEER.

ROBERT FULTON CRAWFORD, Steubenville, O.
A Study of the Thermal Efficiency of a Zinc Furnace.

PAUL ROBERT SNYDER (with C. C. Walters), Bethlehem.
The Influence of Various Paint Coatings on Radiation Losses from Furnaces.

CLARENCE CLAITAN WALTERS (with P. R. Snyder), Bethlehem.
The Influence of Various Paint Coatings on Radiation Losses from Furnaces.

FOR THE DEGREE OF ELECTROMETALLURGIST.

MOSES APPEL, Baltimore, Md.
The Electrolysis of Copper Matte.

JOSEPH RALPH DAWSON, Washington.
The Physical Properties of Electro-plated Alloys.

MAURICE GOOD, Havre de Grace, Md.
The Regeneration of Cyanide Solutions by the Use of Cyanamid.

THOMAS CLAUDE KRAEMER, Pottsville.
A Proposed Method of Electrolytically Treating Speiss.

CLAUDE CALVIN MESSINGER, Allentown.
The Production of Ferro-Boron from Colemanite.

FOR THE DEGREE OF ELECTRICAL ENGINEER.

CARL SAMUEL ALBRIGHT (with S. D. Gladding), Middletown.
A Study of the Effects of Unbalanced Loads on Polyphase Circuits.

CLARENCE BENDER BISHOP (with W. S. Herrmann), Harrisburg.
Tests of Car Lighting Equipments on the Lehigh Valley Railroad.

HENRY HOSFORD FITHIAN (with G. E. Goeppert), Bridgeton, N. J.
Absorption, Diffusion, and Reflection of Wall Surfaces.

FRED EARLEY GALBRAITH, Williamsport.
Characteristics of Integrating Watt-Hour-Meters.

SAMUEL DAWSON GLADDING (with C. S. Albright), Crisfield, Md.
A Study of the Effects of Unbalanced Loads on Polyphase Circuits.

GEORGE EMANUEL GOEPPERT (with H. H. Fithian), Freeland.
Absorption, Diffusion, and Reflection of Wall Surfaces.

JOHN HALDEMAN GRAYBILL (with J. Stair, jr.), Williamsport.
Determination of Power Required to Drive Machine Tools.

WOLDEMAR SIEGFRIED HERRMANN (with C. B. Bishop), Detroit, Mich.
Tests of Car Lighting Equipments on the Lehigh Valley Railroad.

WILLIAM CLINTON PETERMAN, Royersford.
Design and Applications of the Oscillograph.

HAROLD EDWIN RAMSEY, Washington, D. C.
Application of the Heyland Diagram to Small Induction Motors.

JAMES ARTHUR ROSE, Lancaster.
Construction and Characteristics of Electro-Magnets.

JACOB STAIR, JR. (with J. H. Graybill), York.
Determination of Power Required to Drive Machine Tools.

ALFRED JOHN STANDING, Ph.B. (*Dickinson College*), Carlisle.
Electrolysis of Steel Imbedded in Concrete.

CHRISTIAN JACOB UMBLE, M.E. (*Lehigh University*), Lancaster.
Tests on a Single Truck Car of the South Bethlehem and Saucon Street Railway Company.

FOR THE DEGREE OF CHEMICAL ENGINEER.

RAYMOND WILLIAM FAUST, Belvidere, N. J.
Pharmaceutical Investigation of Vanishing Cream.

DANIEL MERRITT FLICK (with P. M. Ginder), Dushore.
Derivatives of Palmitic and Stearic Acids.

PHILIP McLEAN GINDER (with D. M. Flick), Rockport.
Derivatives of Palmitic and Stearic Acids.

JOHN GRIFFEN, South Bethlehem.
Briquetting of Anthracite Coal.

UNIVERSITY DAY.

This day is the last of the academic year, and falls in 1912 on the second Tuesday in June. On this day orations are delivered by members of the graduating class, and degrees are conferred.

EXERCISES ON JUNE 13, 1911.

MUSIC.

PRAYER.

MUSIC.

ALUMNI ADDRESS,

JAMES E. TALMAGE, A.C., '91, PH.D.

PRIZES AWARDED, 1911.

Award of the Wilbur Scholarship of $200 to
CHIMIN CHU-FUH, of Nanziang, Kiang Su, China.
First in rank in the Sophomore Class.

The Williams Graduate Prize of $125 to
CHESTER HAGAR RHODES, of Stroudsburg.

The John B. Carson Prize, for the best thesis in the Civil Engineering Department, to

Othello Henry Schroedl, of Baltimore, Md.

The Alumni Prizes of $25 each, for first honor men in the Junior Class in various departments, were awarded to

Preston Albert Lambert, jr., of Bethlehem.

in the Department of Mechanical Engineering.

Elmer Ellsworth Yake, of Annville.

in the Departments of Mining Engineering, Metallurgical Engineering, and Electrometallurgy.

The Price Prize of $25 for English Composition, open to members of the Freshman Class, was awarded to

Brice Bowman, of Allentown.

The Williams Prizes of $10 and $5 for Excellence in English Composition, open to members of the Sophomore Class, were awarded to

Edward Austin Aurand, of Tamaqua.

Ralph Norman Kocher, of Flicksville.

Thomas John Quinn, of Johnstown.

Harry Smith Rowland, of Schuylkill Haven.

Thomas Leo Dunn, of Fall River, Mass.

William Clinton Fry, jr., of Reading.

Bentley Sayre Shafer, of Montrose.

Sidney David Williams, of Philadelphia.

The Wilbur Prizes of $10 for excellence in the studies of the Sophomore year were awarded as follows:

In Mathematics, to

John Lambert Conner, of Richland Centre.

In English, to

James Herbert Sheppard, of Grand Rapids, Mich.

In Physics, to

Joseph Patrick Stokes, of South Bethlehem.

The Wilbur Prizes of $15 and $10, for excellence in the studies of the Freshman year, were awarded as follows:

In Mathematics, to

George Philip Nachman, of Baltimore, Md., and
Lewis Thornburg, of South Bethlehem.

In English, to

Wilfred Campbell Owen, of Shamokin.

In German, to

George Forster, of Philadelphia.

In French, to

William Francis Bailey, of Summit, N. J.

HONOR LIST.

SENIOR HONORS.

Arts and Science Courses.

First: Carl William Hasek, of Franklin.

Final Honors in Greek: Carl William Hasek, of Franklin.

Civil Engineering Course.

First: William Henry Mohr, of Quakertown.

Second: Carlton Hart Chapin, of Brooklyn, N. Y.

Mechanical Engineering Course.

First: Harry Alter Haas, of Tamaqua.

Second: Edgar Foster Baumgartner, of Asbury Park, N. J.

Mining Engineering Course.

First: Louis Allgaier Rehfuss, of Philadelphia.

Electrical Engineering Course.

First: George Emanuel Goeppert, of Freeland.

Chemistry and Chemical Engineering Courses.

First: Philip McLean Ginder, of Rockport.

Second: Daniel Merritt Flick, of Dushore.

JUNIOR HONORS.

Civil Engineering Course.

First: Ira Alfred St. John, of Perth Amboy, N. J.

Mechanical Engineering Course.

First: Preston Albert Lambert, jr., of Bethlehem.

Second: Nevin Homer Guth, of Allentown.

Mining Engineering Course.

First: Elmer Ellsworth Yake, of Annville.

Chemical Engineering Course.

First: John Ferree Herr, of Strasburg.

SOPHOMORE HONORS.

In Mathematics.

First: Chimin Chu-Fuh, of Nanziang, Kiang Su, China.

Second: John Lambert Conner, of Richland Centre.

Third: George Diller Herr, of Strasburg.

In English.

First: James Herbert Sheppard, of Grand Rapids, Mich.

Second: Bentley Sayre Shafer, of Montrose.

In Physics.
First: Joseph Patrick Stokes, of South Bethlehem.
Second: William Clinton Fry, jr., of Reading.

FRESHMAN HONORS.

In Mathematics.
First: George Philip Nachman, of Baltimore, Md.
Second: Lewis Thornburg, of South Bethlehem.

In English.
Wilfred Campbell Owen, of Shamokin.

In German.
George Forster, of Philadelphia.

In French.
William Francis Bailey, of Summit, N. J.

Degrees in course were then conferred by the President of the University upon the candidates whose names appear in the Thesis List, as given above.

THE WILBUR SCHOLARSHIP.

This scholarship was founded in 1872 by the late E. P. Wilbur, Esq., of South Bethlehem, and is the sum of $200 awarded annually to the student in the Sophomore Class having the best record.

THE HARRY S. HAINES MEMORIAL SCHOLARSHIP.

Mrs. Henry S. Haines, of Savannah, Ga., established in 1889 a scholarship of the annual value of $200 as a memorial of her son, Henry Stevens Haines, M.E., a member of the Class of 1887. This scholarship is devoted to the support at Lehigh University, throughout his scholastic career, of one student in the School of Mechanical Engineering.

THE FRED. MERCUR MEMORIAL FUND SCHOLARSHIPS.

Friends of the late Frederick Mercur, of Wilkes-Barre, Pa., General Manager of the Lehigh Valley Coal Company, desiring to establish a memorial of their friendship and esteem, and to perpetuate his memory, contributed and placed in the hands of the Trustees a fund, called "The Fred. Mercur Memorial Fund," sufficient in amount to insure the award of three scholarships for free tuition in the University.

THE ECKLEY B. COXE MEMORIAL FUND.

In memory of the late Hon. Eckley B. Coxe, Trustee of the University, Mrs. Coxe has established a fund, amounting to $28,000, the interest of which is used, under the direction of the Trustees of the University, and subject to such regulations as they may adopt, for the assistance of students who without such aid would not be able to meet the cost of living as students of the University.

THE FRANK WILLIAMS FUND.

Frank Williams, E.M., of Johnstown, Pa., a graduate of the course in Mining and Metallurgy of the Class of '87, who died October, 1900, bequeathed to the University the greater part of his estate, now amounting to over $120,000, to found a Fund, the income of which is lent to deserving students. At present the larger part of this income is devoted to certain life tenants under Mr. Williams' will. After their detah the entire income will be awarded as above.

WILBUR PRIZES.

A fund was established, yielding an annual income of $100, by the late E. P. Wilbur, Esq., for distribution in prizes as the Faculty shall determine.

THE PRICE PRIZE FOR ENGLISH COMPOSITION.

Dr. Henry R. Price, an Alumnus and Trustee of the University, established in 1898 an annual prize of the value of $25, to be awarded in June to that member of the Freshman Class who shall write the best essay on a topic in English Literature assigned by the head of the department of English not later than the beginning of the Second Term in each year.

In estimating the value of all such essays the greatest stress will be laid upon clearness of thought and idiomatic force of expression; and, in the judgment of the examiner, while looking for correctness of thought in clear and forcible English, expression will take precedence of matter. For this specific end, weight will be given to the form rather than to the matter presented.

Competitors must signify their intention in writing not later than the first of April.

The subject for the prize essay in June, 1912, will be: The Literary Work of Halleck and Drake.

THE JOHN B. CARSON PRIZE.

This prize of $50 annually, was established in 1909 by Mrs. Helen C. Turner, of Philadelphia, Pa., in memory of her father, John B. Carson, whose son, James D. Carson, was a graduate of the Civil Engineering Department of Lehigh University in 1876. It is awarded for the best thesis in the Civil Engineering Department.

ALUMNI PRIZES.

By a resolution of the Alumni Association of September 21, 1900, the Alumni Scholarship Fund, which was originally designed to help poor students, was with the consent of the contributors diverted from this purpose and the income devoted to prizes to members of the Junior Class. In June, 1912, two prizes of $25 each will be awarded to the first honor men of the course in Electrical Engineering and of the group comprising the Junior students in Chemistry and Chemical Engineering. In subsequent years the prizes will be awarded to the first honor men of the other technical courses in turn.

ALUMNI PRIZES FOR ORATORY.

The "Alumni Association of Lehigh University" established in 1882 an annual sum of $50, to be distributed in prizes for excellence in Oratory, subject to the following

REGULATIONS.

1. The contest shall be held on the 22d day of February, or on the day designated by the University to commemorate the birthday of Washington.

2. There shall be a first prize of $25, a second of $15, and a third of $10.

3. To entitle one to be a competitor he must be a member of the Junior Class, taking a regular course.

4. Subjects for the orations shall be announced at the beginning of the first term of every year, and upon one of these each competitor shall write an oration not to exceed 1200 words, taking about eight minutes in delivery.

5. Each oration shall bear upon its first page a fictitious name or motto, and shall be accompanied by a sealed envelope, which shall be superscribed with the same name or motto, and an address by which it may be reclaimed. The envelope shall contain the real name and address of the writer, with the declaration

that the oration is his own original work. The examiner, having adopted a standard of excellence, may reject any or all of the orations presented which do not attain to this standard; of such as do—should they be sufficient in number—the best six shall be chosen, and their envelopes opened. The others shall be returned to the addresses given with their envelopes unopened.

6. The Executive Committee of the Alumni Association, or a committee of not fewer than three to be appointed by them, shall hear the competitors whose orations shall have been approved, and the awards shall be made by a majority of these judges.

7. In awarding the prizes the judges shall consider both the literary merits and the delivery of each oration.

8. These rules are subject to amendment by the Faculty.

CELEBRATION OF WASHINGTON'S BIRTHDAY.

The annual contest in Oratory for the Alumni Prizes was held on February 22, 1911, with the following competitors:

Ernest Shaffer Colling, of Oil City.

David Davies, of Plymouth.

Harold Jacob Williams, of Annville.

Robert Hall Woods, of Baltimore, Md.

The First Prize was awarded to H. J. Williams, the Second to E. S. Colling, and the Third to R. H. Woods.

The Judges were Frederick W. Robbins, the Rev. Francis S. Hort, and Robert E. Laramy, '96.

WILLIAMS PRIZES IN ENGLISH.

Prof. Edward H. Williams, jr., an alumnus of the University, a graduate of the Class of 1875, established in February, 1900, prizes amounting annually to three hundred and thirty-five dollars for excellence in English Composition and Oratory, to secure which he has placed an ample endowment in the hands of the Trustees of the University. The conditions of the endowment are as follows:

Sophomore Composition Prizes.

1. At the beginning of each term the Sophomore Class shall be divided into two sections alphabetically and to that student in each section who, at the end of a term, and of each term, shall receive the highest rank in English Composition during that term shall be awarded the "First Sophomore Composition Prize" of ten dollars, and to that student in each section as aforesaid who shall receive the next highest rank in the same subject shall be awarded the "Second Sophomore Composition Prize" of five dollars. In each year there will be offered four first and four second prizes—a total of sixty dollars.

If more than one student shall receive the highest rank in any section, the amount of the two prizes shall be added together and the sum—fifteen dollars—shall be equally divided between them, and no second prize shall be offered to that section. If more than one student shall receive the next highest rank in any section where there is but one contestant for the first prize, the second prize shall be equally divided between the two having the second rank.

Senior Premiums.

2. The Faculty shall publish within one month of the end of the University year a list of subjects for dissertations, selected from English Literature and Economics, entitled Subjects for Senior Premiums. To this list shall be appended a date near the first of January following—to be determined upon by the Faculty —when the contest shall be declared closed and the dissertations shall become due.

From the above list any member of the Senior Class may select a subject and write thereon a dissertation, whose length shall be prescribed by the Faculty, and shall send the same anonymously, but marked for identification, as the Faculty may direct, to the Secretary of the Faculty before the date aforesaid.

The Faculty, or its committee, shall meet on the above date and at subsequent adjourned meetings, and, first, having determined upon a standard of excellence which each and all dissertations must reach in order to be admitted to the following competition, shall examine the dissertations submitted to them and admit those which reach the above standard. In case none are up to the standard, and are admitted, they shall declare the contest closed for that year, and no prizes shall be awarded.

If one or more dissertations are admitted as aforesaid, the Faculty, or its committee, shall arrange them in the order of their literary merit and soundness of their reasoning, and the six highest in this arrangement shall be retained and all others returned as directed by the writers, who shall remain unknown. The names of the successful writers shall be ascertained and they shall be required to recast their dissertations in the form of an oration, and to speak the same in public at such time during the Commencement Week as the Faculty shall determine.

The Faculty, or its committee, shall be the judges of excellence in the speaking, and shall award to that Senior student who shall speak his oration in the best manner, the Senior Gold Medal,

of the value of one hundred dollars, or, at his option, one hundred dollars in gold. They shall award to the other five speakers the five Senior Premiums of ten dollars each.

Graduate Prize.

3. At the end of the University year, during Commencement Week, the Faculty shall publish a second list of subjects for theses selected from English Literature, Economics, Mental and Moral Science, and similar subjects which require thought and application, and which must be of such a character that their mastery shall be accomplished only through considerable research and study.

From this list any member of the class just graduating; the Senior Class of the coming University year; a graduate of one year's standing whether in or out of residence, and a graduate of any class who may be, during the coming year, in actual residence and taking post-graduate work in the University, may select a subject and write thereon a thesis of not less than five thousand words and send the same to the Secretary of the Faculty, anonymously, but marked for identification as the Faculty may designate, before the date, which the Faculty shall select within one month before the next Commencement, and which date must appear on the above list.

The Faculty, or its committee, shall meet on this date, and at adjourned meetings thereafter, and, having first established a standard of excellence, which must, first, be a high one, and second, shall require on the part of the competitor ability in the plan, development, argument, and conclusion of the work, as well as literary merit in its composition and presentation, shall admit to the following competition only those which fully attain to the above required standard.

If none of the theses submitted shall have attained to the standard aforesaid, the competition shall be declared closed and the prize shall not be awarded.

To the author of that thesis which shall have been admitted to the competition, and which shall have been declared of the highest excellence, the Graduate Prize of one hundred and twenty-five dollars shall be awarded and presented on Commencement Day with the other prizes and awards of that day.

The successful thesis shall be the property of the University, but the author shall be allowed to retain one copy. Publication of the thesis by the author will only be permitted by vote of the Faculty. Such publications must, however, be entitled Graduate Prize Thesis of the Lehigh University.

The winner of a prize shall not be allowed to compete again.

Prof. Williams has directed that the income derived from the endowment for the Williams Prizes shall be applied and used as follows:

1. All portions of said income remaining after the payment of all prizes awarded in any one year, shall be invested and added to the principal of said endowment.

2. If any prize shall, for any reason, be not awarded in any year, the sum thus unpaid shall be invested and added to the said principal.

3. If for any reason the amount of the income from said endowment shall fall below the total sum necessary to pay said prizes, the amounts of the individual prizes shall be proportionally reduced till their sum shall be equal to three-fourths of the said reduced income, and this three-fourths shall be used to pay them; the remaining one-fourth is to be invested and added to the said principal.

4. This investment of residues, as above said, shall continue till the principal of said endowment shall be sufficiently large to furnish an income at two per cent. interest, which will be sufficient to pay all said prizes now established.

5. When said principal shall be large enough to furnish the necessary sum to defray the said prizes, as stated in No. 4, the surplus income remaining after paying all the prizes awarded during the year shall be used by the President of the University to encourage oratory, debate, or any other object decided upon by the Faculty.

THE FRAZIER AND RINGER MEMORIAL FUND.

This is a fund for the medical and surgical care of needy students, established in memory of Benjamin West Frazier, A.M., Sc.D., formerly Professor of Mineralogy and Metallurgy, and Severin Ringer, U.J.D., formerly Professor of Modern Languages and Literatures and of History, each of whom faithfully served Lehigh University for one-third of a century. The fund was started February 12, 1906, by the donation by Robert H. Sayre, Esq., of thirteen thousand dollars, the income of which is now available for the above purposes. It is the hope and expectation of the friends of the University that this fund may, by other donations, be increased in time to amount to a sum sufficient to insure free medical and surgical attendance to all students of the University requiring such aid.

STUDENTS.

B.A.—Bachelor of Arts.
B.S.—Bachelor of Science.
C.E.—Civil Engineering.
Ch.E.—Chemical Engineering.
Chem.—Chemistry.
E.E.—Electrical Engineering.
El.Met.—Electrometallurgy.
E.M.—Mining Engineering.
M.E.—Mechanical Engineering.
Met.—Metallurgical Engineering.

The names in the following lists include all the students who have registered and attended recitations at the University for the current year.

GRADUATE STUDENTS.

	For Degree.	Residence.
Alrich, George Frederick, B.S., (*Lafayette College.*)	M.S.,	Easton.
Bartlett, Ralph L., B.S., (*Mass. Inst. of Technology.*)	M.S.,	South Bethlehem.
Carson, Walter Cornelius, C.E., (*Lehigh University.*)	M.S.,	Philadelphia.
Charles, Rollin Landis, M.A., (*Lehigh University.*)	Spl.,	South Bethlehem.
Cloke, Paul, E.E., (*Lehigh University.*)	M.S.,	Kingston, R. I.
Durell, Henry Eugene Allston, A.B., (*St. Stephen's College.*)	M.A.,	Mauch Chunk.
Enzian, Charles, C.E., (*Lehigh University.*)	M.S.,	Wilkes-Barre.
Estabrook, Edward L., E.M., (*University of Pittsburgh.*)	M.S.,	South Bethlehem.
Foster, Edward Staniford, E.E., (*Lehigh University.*)	M.S.,	Bethlehem.
Fry, Howard Massey, E.E., (*Lehigh University.*)	M.S.,	Bethlehem.
Gruber, Howard Dietrich, E.E., (*Lehigh University.*)	M.S.,	South Bethlehem.
Heck, Lewis, B.A., (*Lehigh University.*)	M.A.,	Jerusalem, Syria.

	For Degree.	Residence.
Hess, Lloyd Franklin, B.A., (*Lehigh University.*)	M.A.,	Bethlehem.
Hu, Heng Tsing, C.E., (*Lehigh University.*)	M.S.,	Soochow, China.
Huang, Saosen Ken, E.M., (*Lehigh University.*)	M.S.,	Shanghai, China.
Knauss, James Owen, B.A., (*Lehigh University.*)	M.A.,	Catasauqua.
Myers, Arthur H., Ph.B., (*Lafayette College.*)	M.A.,	Freeland.
Odom, William F., B.S., (*Clemson College.*)	M.S.,	South Bethlehem.
Perley, Frank Glen, E.M., (*Lehigh University.*)	M.S.,	South Bethlehem.
Rhodes, Chester Hagar, B.A., (*Lehigh University.*)	M.A.,	Stroudsburg.
Robbins, William Jacob, B.A., (*Lehigh University.*)	M.A.,	Lebanon.
Rominger, Charles Herman, M.A., (*Moravian College.*)	M.A.,	Bethlehem.
Siebert, Christian L., B.S., (*Lafayette College.*)	M.S.,	Bethlehem.
Smith, Herman Percy, E.M., (*Lehigh University.*)	M.S.,	South Bethlehem.
Walters, Raymond Wadsworth, B.A., (*Lehigh University.*)	M.A.,	Bethlehem.
Wily, James Hunter, E.E., (*Lehigh University.*)	M.S.,	South Bethlehem.
Baker, Francis Howland, Ph.B., (*Yale University.*)	M.E.,	South Bethlehem.
Bauman, John Edmiston, A.B., (*Muhlenberg College.*)	C.E.	Allentown.
Curtis, John Raymond, A.B., (*Rock Hill College.*)	M.E.,	Ellicott City, Md.
Dayton, Roscoe Bartlett, A.B., (*Marietta College.*)	C.E.,	New Martinsville, W. Va.
Faherty, John Patrick, A.B., (*Rock Hill College.*)	C.E.,	Washington, D. C.
Florian, Erasmus Andre, B.S., (*St. Louis College.*)	M.E.,	San Antonio, Texas.

	For Degree.	Residence.
Howarth, Harry Arthur Stevens, Ph.B., (*Yale University.*)	M.E.,	South Bethlehem.
Kerr, Horace Donald, B.A., (*Lehigh University.*)	C.E.,	Titusville.
Menefee, Walter Biggers, A.B., (*Randolph-Macon College.*)	C.E.,	Lynchburg, Va.
Parker, Raymond Vincent, A.B., (*Rock Hill College.*)	M.E.,	Portsmouth, Va.
Raese, Cleon Wilson, B.S., (*Davis and Elkins College.*)	E.E.,	Davis, W. Va.
Reiter, Jacob Luther, A.B., (*Muhlenberg College.*)	M.E.,	Allentown.
Schulz, Carl Alexander, B.A., (*Lehigh University.*)	M.E.,	South Bethlehem.
Wunder, Edgar Douglas, A.B., (*Randolph-Macon College.*)	E.E.,	Woodstock, Va.

SPECIAL GRADUATE STUDENTS.

	Course.	Residence.
Hartzell, Arthur Rupp, A.B., (*Franklin & Marshall College.*)	Chem.,	Allentown.
Londoño, Alejandro, E.M., (*University of Antioquia.*)	Met.,	Medellin, Colombia.
Mitman, Carl Weaver, B.A., (*Lehigh University.*)	B.S.,	South Bethlehem.
Platt, Joseph Eyre, B.S., (*Pennsylvania State College.*)	B.A.,	Norristown.
Vela, José Ignacio, M.E., (*Lehigh University.*)	C.E.,	Ambato, Ecuador.
Whiteley, Joseph Osborne, Litt.B., (*Princeton Univ.*)	Met.,	York.

SENIOR CLASS.

CLASS OF 1912.

	Course.	Residence.
Austin, Eugene Howard,	E.E.,	Toms River, N. J.
Bacon, John Earl,	Ch.E.,	Camden, N. J.
Bailey, James,	M.E.,	Brooklyn, N. Y.
Bender, Charles Harry,	E.M.,	South Bethlehem.
Benjamin, Harry Moses,	C.E.,	Hazleton.
Birdsall, Amos Glentworth,	E.E.,	Toms River, N. J.

Birnie, Clotworthy, jr.,	E.E.,	Taneytown, Md.
Black, Alexander Gordon,	Chem.,	Fort McKavett, Texas.
Boas, Robert Hendel,	M.E.,	Reading.
Bonine, Chesleigh Arthur,	E.M.,	Bethlehem.
Cann, Carlton DeVere,	C.E.,	Baltimore, Md.
Carroll, John Marshall,	C.E.,	Baltimore, Md.
Catanach, Royden Wersler,	E.E.,	Devault.
Coakley, Maurice Thomas,	Ch.E.,	Shenandoah.
Colling, Ernest Shaffer,	B.A.,	Oil City.
Cook, Eber Waddell,	M.E.,	New Castle.
Cooper, Herbert Leonard,	C.E.,	Chicopee, Mass.
Crellin, John Richards,	E.E.,	Hazleton.
Davis, Frank Wilson, jr.,	El.Met.,	Milford, Del.
Davis, Walter Herman,	M.E.,	Spring City.
Douglass, Wheaton,	M.E.,	Cape May Court House, N. J.
Eagle, Henry,	El.Met.,	Pottstown.
Edwards, Vere Buckingham,	C.E.,	Glenburn.
Fahm, Frank, jr.,	C.E.,	Laurel, Md.
Flayhart, Clarence Joshua,	C.E.,	Baltimore, Md.
Fowler, Horace Shipp,	M.E.,	Wilkes-Barre.
Fuller, Raymond Chester,	C.E.,	Sussex, N. J.
Gauss, Chester Arthur,	E.E.,	Washington, D. C.
Goldberg, Richard,	C.E.,	Lancaster.
Gore, James, jr.,	C.E.,	Reisterstown, Md.
Guth, Nevin Homer,	M.E.,	Allentown.
Hadsall, Warren Fuller,	C.E.,	Forty Fort.
Hancock, William Krebs,	E.E.,	Danville.
Hanger, Samuel Ryland,	B.A.,	Florence, N. J.
Harris, Thomas Philip,	E.E.,	Hazleton.
Hart, John Ambrose,	E.E.,	Mayfield.
Hartley, Burton,	E.M.,	East Orange, N. J.
Hartzell, Milton Brindle,	C.E.,	Fayetteville.
Hauk, Raymond John,	Chem.,	Lehighton.
Herr, John Ferree,	Ch.E.,	Strasburg.
Hill, Lyman Forst, jr.,	C.E.,	Trenton, N. J.
Horn, Henry Joseph,	C.E.,	Baltimore, Md.
Jenkins, James Martin,	E.M.,	Philadelphia.
Jerman, Daniel Thomas,	C.E.,	New York, N. Y.
Johnson, William Matthew,	E.E.,	Freeland.
Kennedy, Andrew Milliken,	C.E.,	Youngstown, O.

Kester, Carl Daniel,	E.E.,	Spencer, N. C.
Knox, Lester Bunn,	El.Met.,	Christiana.
Lambert, Preston Albert, jr.,	M.E.,	Bethlehem.
Laub, Allen Victor,	B.A.,	Bethlehem.
Lazarus, William Hill,	C.E.,	Mount Carmel.
Lehr, Edmund Bruce,	B.S.,	Allentown.
Lubrecht, Frank Spargo,	C.E.,	Hazleton.
McCoy, John Gibbon,	M.E.,	South Bethlehem.
McFetridge, Clyde Kemerer,	Chem.,	Allentown.
Martin, Allen Gerard,	E.E.,	Brooklyn, N. Y.
Miller, Frank Bernard,	C.E.,	Dunmore.
Milnor, Joseph Willard,	E.E.,	Williamsport.
Moore, Walter Robert,	M.E.,	Sussex, N. J.
Nevius, Walter Irving,	E.E.,	Philadelphia.
Newman, Willard Levi,	E.E.,	Blairstown, N. J.
Nusbaum, John William,	E.E.,	Lehighton.
Otto, Henry Habel,	E.M.,	Wilkes-Barre.
Perry, Howard Francis,	E.E.,	Philadelphia.
Peters, Simon Cameron, jr.,	C.E.,	Middletown.
Porter, Horace Wray,	E.E.,	New York, N. Y.
Robb, Edward Henry,	M.E.,	Lebanon.
Rorer, William Nyce,	E.E.,	Philadelphia.
Rutherford, Arthur Parke,	E.E.,	Harrisburg.
St. John, Ira Alfred,	C.E.,	Perth Amboy, N. J.
Samuels, Irving H.,	E.E.,	Allentown.
Sanchez, Pedro Eulogio,	C.E.,	San Pedro, Mexico.
Schultz, Andrew Thompson,	E.E.,	Pittsburgh.
Sencenbach, Charles Franklin,	M.E.,	Bath.
Seyfried, Warren Raymond,	Ch.E.,	Bethlehem.
Shurts, George Jacob,	E.E.,	Somerville, N. J.
Sieger, George Nathan,	El.Met.,	Slatington.
Smyth, Harold Morgan,	E.M.,	Pottsville.
Snyder, Charles Stephen,	C.E.,	South Bethlehem.
Snyder, Luther Thomas,	C.E.,	Kimberton.
Solly, Walter Cleveland,	C.E.,	Philadelphia.
Solomon, James Arthur,	M.E.,	Bethlehem.
Speed, Frederick Rice,	B.S.,	Catonsville, Md.
Spooner, Albert Poole,	Met.,	Harrisburg.
Terwilliger, Merle Ivan,	E.M.,	Scranton.
Tinges, Henry Belin,	M.E.,	Wilmington, Del.
Trexler, Edwin Walter,	M.E.,	Allentown.

von Konecny, Charles Theodore,	Ch.E.,	Scranton.
Waddington, William Herbert,	C.E.,	Bayonne, N. J.
Wagner, Carl Eddy,	C.E.,	Fort Morgan, Col.
Wenner, Ralph Schaffer,	E.E.,	Allentown.
Wheaton, Ezra Almon,	Met.,	Franklin Forks.
Whyte, Clifford Riddle,	E.M.,	Washington, D. C.
Williams, Harold Jacob,	M.E.,	Annville.
Williams, Ralph Bradford,	E.M.,	Scranton.
Wilson, William May,	E.E.,	Riverdale, Md.
Wood, Donald Burchell,	M.E.,	Pelham, N. Y.
Wotring, Arthur Francis,	E.E.,	Schnecksville.
Wright, Earl Emmons,	E.M.,	Bristol, Conn.
Yake, Elmer Ellsworth,	E.M.,	Annville.
Youry, Franklin Weems,	C.E.,	Newark, N. J.

JUNIOR CLASS.

CLASS OF 1913.

	Course.	Residence.
Ackerly, Orville Burnell, jr.,	M.E.,	Yonkers, N. Y.
Aurand, Edward Austin,	C.E.,	Tamaqua.
Baird, Ralph P.,	B.S.,	Pittsburgh.
Bartholomew, Frank Jonas,	Chem.,	Fullerton.
Beers, Jesse Franklin,	M.E.,	Bath.
Blackman, Harold Ross,	C.E.,	New York, N. Y.
Bowen, Ezra, 4th,	B.S.,	Burlington, N. J.
Bowman, Donald,	E.M.,	Brooklyn, N. Y.
Boyer, Emmett Frank,	C.E.,	Bowmanstown.
Brinton, Charles Pugh,	C.E.,	Gap.
Bryant, Thomas Almeran,	B.S.,	Brooklyn, N. Y.
Bryce, Richard Marion,	M.E.,	Pittsburgh.
Camp, Herbert Asbury,	B.S.,	Hattiesburg, Miss.
Campbell, Robert,	C.E.,	Pottstown.
Carpenter, Laurence Everett,	Ch.E.,	Newburgh, N. Y.
Chu-Fuh, Chimin,	C.E.,	Nanziang, Kiang Su, China.
Chun, Wing King,	M.E.,	Hankow, China.
Clarke, Joseph Louis,	E.M.,	Mineville, N. Y.
Clemmitt, Willis Butler,	E.M.,	Baltimore, Md.
Clewell, Reginald Francis,	M.E.,	Bethlehem.
Cole, Benjamin Ely,	M.E.,	Bethlehem.
Conner, John Lambert,	E.E.,	Richland Centre.
Cook, Theodore Henry,	M.E.,	Philadelphia.

Cooper, Jehu Patterson,	Met.,	Red Bank, N. J.
Cosgrove, Albert Kemmer,	B.S.,	Hastings.
Cox, Henry Randall,	C.E.,	New York, N. Y.
Croft, Harry Pinkerton,	C.E.,	Camden, N. J.
Culliney, John Edgar,	M.E.,	Lebanon.
Cunningham, James Earl,	B.S.,	Johnstown.
De Nyse, Rondo Christery,	C.E.,	Long Branch, N. J.
Donaldson, George Maclennan,	C.E.,	Huntington, N. Y.
Douglas, Morris Duncan,	M.E.,	Philipsburg.
Dugan, Walter John,	E.E.,	Hazleton.
Dunbar, Douglas MacDonald,	E.M.,	New York, N. Y.
Dunn, Thomas Leo,	C.E.,	Fall River, Mass.
Du Tot, Stewart Clair,	Chem.,	Stroudsburg.
Dynan, Robert Teace,	E.M.,	Bethlehem.
Evans, Alvin,	C.E.,	Hazle Brook.
Evans, Daniel Kinsman,	E.M.,	Carbondale.
Fahl, Roy Jackson,	M.E.,	Camden, N. J.
Fellencer, Charles Allen,	E.M.,	Allentown.
Finn, Ernest Erastus,	M.E.,	Montrose.
Ford, Sydney Henry Waterlow,	M.E.,	San Francisco, Cal.
Francis, Charles Wellman,	E.M.,	Steelton.
Fritz, John Milton,	C.E.,	Wilkes-Barre.
Fry, William Clinton, jr.,	C.E.,	Reading.
Fuhrmann, Ira,	C.E.,	Roebling, N. J.
Gerhard, Francis Johnston,	M.E.,	East Orange, N. J.
Gery, Ambrose Stanley,	Chem.,	Coopersburg.
Gonder, Joseph Maynard,	Chem.,	Strasburg.
Gorman, Alan Bowen,	El.Met.,	Catonsville, Md.
Griffen, Henry Ramsey,	E.M.,	South Bethlehem.
Harris, George Edward, jr.,	C.E.,	Baltimore, Md.
Harrison, Alexander,	C.E.,	Ardmore.
Herr, George Diller,	M.E.,	Strasburg.
Hill, George Cooper,	E.M.,	Washington, D. C.
Hirshberg, Frank Isador,	E.M.,	South Milwaukee, Wis.
Horcasitas, Augustin Segismund,	E.M.,	Chihuahua, Mexico.
Jamieson, Andrew Douglas,	El.Met.,	Lawrenceville, N. J.
Janeway, Price Wetherill, jr.,	M.E.,	Media.
Johnson, Hjalmar Edward,	M.E.,	Titusville.
Kalajan, Alexander,	C.E.,	Providence, R. I.
King, Walter Robert,	C.E.,	Passaic, N. J.

Kocher, Ralph Norman,	B.A.,	Flicksville.
Kutzleb, August Julius,	C.E.,	Baltimore, Md.
Lamb, Herbert Will,	E.M.,	Adrian, Mich.
Lenker, Harold Edwin,	E.M.,	Schuylkill Haven.
Levan, Daniel Haydn,	E.M.,	Reading.
Lewis, Frank Hall,	C.E.,	Jerusalem, Md.
Loane, Charles Edwin, jr.,	M.E.,	Oil City.
Lyon, Joseph Immell,	C.E.,	Chambersburg.
McComas, William Edwin, jr.,	C.E.,	Baltimore, Md.
McMenamin, Peter John,	M.E.,	Jeddo.
Mart, Leon Thomas,	M.E.,	Hammonton, N. J.
Martin, John Traylor,	E.M.,	San Antonio, Texas.
Matamoros, Juan Loria,	C.E.,	San José, Costa Rica.
Matthews, Leslie Goddard,	Chem.,	Newark, N. J.
Messenger, Frank Cornelius, jr.,	E.M.,	Malden, Mass.
Miller, Charles Walter,	C.E.,	Baltimore, Md.
More, James Florian,	C.E.,	Bethlehem.
Motter, Harry William,	E.E.,	York.
Muthart, Stanley E.,	E.M.,	Reading.
O'Brien, Alfred Lawrence,	E.M.,	Chelsea, Mass.
Olson, Alfred Elbert,	E.E.,	Wallingford, Conn.
Over, Raymond Wilbur,	E.E.,	Haysville.
Petty, Morris Kent,	E.M.,	Crafton.
Plack, Ferdinand Henry,	C.E.,	Baltimore, Md.
Price, Edward Foley,	M.E.,	Danville.
Quincy, Edmund,	C.E.,	New York, N. Y.
Quinn, Thomas John,	B.S.,	Johnstown.
Quirk, Barton Bird,	C.E.,	Hatboro.
Rafter, Case Broderick,	C.E.,	Washington, D. C.
Raynor, Kenneth Mills,	E.E.,	Carbondale.
Rehfuss, William Clifford,	E.M.,	Philadelphia.
Rems, Raymond Jacob,	C.E.,	Allentown.
Robell, Joseph Charles,	M.E.,	Hazle Brook.
Rooney, Henry Lloyd,	M.E.,	Newport, R. I.
Rouse, Hayden Kemble,	C.E.,	Newton, N. J.
Rowland, Harry Smith,	Chem.,	Schuylkill Haven.
Rupp, Guy,	C.E.,	Mechanicsburg.
Savastio, Leonard Bruce,	C.E.,	Waltonville.
Schmidt, William James,	E.M.,	Newport, R. I.
Schneider, Conrad Andrew,	M.E.,	Trenton, N. J.
Seguine, William, jr.,	El.Met.,	Rosebank, N. Y.

Shafer, Bentley Sayre,	B.A.,	Montrose.
Shaw, Milton Maurice,	M.E.,	Newtown.
Sheppard, James Herbert,	M.E.,	Grand Rapids, Mich.
Speed, Fletcher Barnes, jr.,	E.M.,	Catonsville, Md.
Spencer, Benjamin Harrison,	M.E.,	Granville Summit.
Stokes, Joseph Patrick,	El.Met.,	South Bethlehem.
Streets, Carll Rees,	B.A.,	Bridgeton, N. J.
Sultzer, Morton,	E.E.,	Baltimore, Md.
Sutherland, Malcolm Read,	C.E.,	New York, N. Y.
Tice, Herbert Wesley,	E.E.,	Trexlertown.
Trujillo, Alberto,	C.E.,	Matanzas, Cuba.
Van Nort, Collins Wallace,	C.E.,	Scranton.
Walker, Joseph Paul,	B.S.,	Birmingham, Ala.
Wallace, Donald Franklin,	E.M.,	East Orange, N. J.
Watrous, Roswell Miller,	E.M.,	Montrose.
Watson, Robert Clement,	C.E.,	Washington, D. C.
Weaver, Earle Fellencer,	E.E.,	Bethlehem.
Wheeler, Frank Ignatius, jr.,	C.E.,	Towson, Md.
White, Andrew Keness,	Chem.,	Chicopee, Mass.
Williams, Sidney David,	El.Met.,	Philadelphia.
Wylie, Charles Robert, jr.,	E.M.,	Pottstown.

SOPHOMORE CLASS.

CLASS OF 1914.

	Course.	Residence.
Abbott, Frank Roderic,	B.S.,	New York, N. Y.
Ash, Simon Harry,	E.M.,	Roslyn, Wash.
Aungst, Daniel Stauffer,	E.E.,	Landisville.
Backes, Clifford Burton,	M.E.,	Wallingford, Conn.
Bailey, William Francis,	C.E.,	Summit, N. J.
Baird, Donald Galbraith,	B.A.,	Philadelphia.
Baker, Russell Ingram,	Chem.,	Lewistown.
Baldwin, Howard Denton,	E.E.,	Chicopee, Mass.
Bell, William Graham, jr.,	C.E.,	New Bethlehem.
Bianco, Fred,	E.M.	Roslyn, Wash.
Bickley, Creighton Daniel,	M.E.,	Newark, N. J.
Bleiler, Ira James,	M.E.,	Allentown.
Brady, Richard Michael,	C.E.,	South Bethlehem.
Bristor, Alan Falconer,	E.E.,	Baltimore, Md.
Brooke, William Clement,	M.E.,	Joppa, Md.
Browne, William Roger,	C.E.,	Westfield, N. J.
Burdick, Harold Lawrence,	M.E.,	Scranton.

Burns, Stephen William,	C.E.,	Grafton, W. Va.
Butler, Alexander Wilson,	E.E.,	Mauch Chunk.
Callen, Arthur Spencer,	El.Met.,	Pottstown.
Cameron, Glenn Marr,	M.E.,	Houtzdale.
Castellanos, Eneas Cosme,	C.E.,	Guines, Cuba.
Chaffe, John Charles,	M.E.,	Elizabeth, N. J.
Chandler, Edward Williamson,	E.E.,	Harriman, Tenn.
Charnock, Percival Roger,	C.E.,	Punxsutawney.
Church, Owen Briggs,	E.E.,	Oxford, N. Y.
Clarke, Thomas McLaughlin,	C.E.,	Hokendauqua.
Colcord, Webster Hinkley,	C.E.,	Saratoga Springs, N. Y.
Coleman, Thomas Bell,	B.S.,	Pittsburgh.
Cooper, Alfred Clapp,	Met.,	Chicopee, Mass.
Danner, John Russell,	E.E.,	Siegfried.
Degler, Howard Edward,	M.E.,	Womelsdorf.
Dewey, Edwin Swinker,	El.Met.,	Haddonfield, N. J.
Diefenderfer, John Harold,	B.A.,	Bethlehem.
Donaldson, John Willcox,	M.E.,	Baltimore, Md.
Downs, Thomas Watson,	El.Met.,	Steelton.
Drant, Reginald,	C.E.,	Montgomery, N. Y.
Driscoll, Frank Edgar,	E.M.,	Somerville, N. J.
Duncan, William Rothermel,	E.M.,	Philadelphia.
Edwards, Charles Lewis Taylor,	Met.,	Pueblo, Col.
Ewing, Wylie Barker,	E.E.,	Wheeling, W. Va.
Faust, Harry Cockill,	E.M.,	Shamokin.
Flick, George Paul,	E.E.,	Tarentum.
Forster, George,	E.E.,	Philadelphia.
Frank, Irving,	C.E.,	Lancaster.
Galainena, Mariano,	M.E.,	Guanajay, Cuba.
Galloway, Robert Rankin,	M.E.,	Takoma, D. C.
Gatch, Frederick Talbott,	C.E.,	Raspeburg, Md.
Gemmel, John Swartz,	E.E.,	Catasauqua.
Gifford, Richard Haight,	C.E.,	Philadelphia.
Gift, Robert Ayres,	M.E.,	Allentown.
Gilroy, Robert William,	B.S.,	Mount Vernon, N. Y.
Gomez, Andres,	C.E.,	Havana, Cuba.
Goyne, Eckley Brinton Coxe,	M.E.,	Norfolk, Va.
Graham, Herbert Winfield,	E.E.,	Johnstown.
Green, Leroy Seeman,	M.E.,	Baltimore, Md.
Griffith, Harvey Conrad,	E.E.,	Conemaugh.
Hadaway, Seymour,	C.E.,	East Orange, N. J.

Harkness, John Law,	M.E.,	Pittston.
Hartdegen, Carl, jr.,	C.E.,	Newark, N. J.
Hearne, Thomas Weston,	E.M.,	Wayne.
Helfrich, John Wert,	El.Met.,	Carrollton, O.
Hettler, William Martin,	C.E.,	Philadelphia.
Hohl, Raymond Charles,	Ch.E.,	Philadelphia.
Horn, James Thomas,	M.E.,	Catasauqua.
Howard, William Edward, 2d,	C.E.,	Chester.
Jay, Henry Davis,	M.E.,	Baltimore, Md.
Johnson, Theodore Tyler, jr.,	Chem.,	Elizabeth, N. J.
Jordan, Richard Dudley,	Ch.E.,	Rutherford, N. J.
Joseph, David John,	M.E.,	Wilkes-Barre.
Kavanaugh, John Dennis,	M.E.,	Baltimore, Md.
Killough, Walton Barr,	E.E.,	Elizabeth, N. J.
Krause, Robert Samuel,	M.E.,	Richland Centre.
Krause, Walter Beyerle,	Ch.E.,	Lebanon.
Lacombe, Luiz Lourenco,	E.E.,	Philadelphia.
Laedlein, Robert Auguste,	E.E.,	Williamsport.
Lawall, Charles Elmer, jr.,	E.M.,	Catasauqua.
Lawshe, Verner Thatcher,	Ch.E.,	Newark, N. J.
Leonard, Arthur Bruton,	M.E.,	Baltimore, Md.
Lesesne, Lucian McCutchen,	B.S.,	Vicksburg, Miss.
Lewis, George,	Ch.E.,	Washington, D. C.
Liebig, John Orth,	Met.,	Sparrows Point, Md.
Linderman, Garrett Brodhead, jr.,	E.M.,	Cynwyd.
Long, James Scott,	Ch.E.,	York.
Loos, Christopher Earle,	C.E.,	Baltimore, Md.
Lopez, Hector,	C.E.,	Granada, Nicaragua.
MacHardy, Alexander Charles,	E.M.,	Greensburg.
McCaffrey, Edward John,	E.E.,	Dorchester, Mass.
McCauley, Hiram Strobridge,	C.E.,	Atlanta, Ga.
McConnor, William Frederick,	M.E.,	Baltimore, Md.
McKay, James Hughes,	C.E.,	Baltimore, Md.
McKenzie, Alexander, jr.,	E.M.,	New York, N. Y.
McLaughlin, Erwin Robert,	E.E.,	Baltimore, Md.
Mayers, Henry Horace,	Ch.E.,	Reading.
Mercur, James Watts, jr.,	B.S.,	Wallingford.
Merwin, Miles Henderson,	El.Met.,	Pittsburgh.
Mickel, Robert Eli,	E.M.,	Wildwood, N. J.
Montgomery, John Lippincott,	C.E.,	South Amboy, N. J.
Morse, John Hamilton,	B.A.,	Troy.

Nachman, George Philip,	M.E.,	Baltimore, Md.
Neff, Russell Meade,	M.E.,	Allentown.
Nordenholt, George Fred,	M.E.,	Stapleton, N. Y.
Orr, James Lawrence,	C.E.,	Buffalo, N. Y.
Orr, William James,	Chem.,	Chicopee, Mass.
Overfield, Gerald Maxwell,	C.E.,	Bethlehem.
Owen, Wilfred Campbell,	M.E.,	Shamokin.
Packard, Charles Lee,	C.E.,	Baltimore, Md.
Parks, Joe Baxter,	E.E.,	Concord, N. C.
Peale, Richard,	E.M.,	St. Benedict.
Penniman, Charles Frederic,	M.E.,	Asheville, N. C.
Perkins, Walter Frederick,	C.E.,	Baltimore, Md.
Peterson, David McKelvy,	C.E.,	Honesdale.
Pettigrew, Charles William,	C.E.,	New York, N. Y.
Pittinger, Benjamin Ryerson,	E.M.,	Oxford, N. J.
Polster, Milton Adolph,	E.E.,	Baltimore, Md.
Poust, Herbert Millard,	E.E.,	Kingston.
Prickett, Stanley Gordon,	E.E.,	Wilmington, Del.
Protzeller, Raymond Joseph,	E.M.,	North Catasauqua.
Quast, Walter Flamm,	M.E.,	Baltimore, Md.
Rebert, Burton Reginald,	B.S.,	South Bethlehem.
Rees, David Harrison,	B.A.,	Bethlehem.
Richardson, Wm. Galloway, jr.,	M.E.,	Baltimore, Md.
Richmond, Charles Preston,	E.M.,	Bethel, Conn.
Rosenbaum, Alfred Newberger,	E.M.,	Easton.
Ryder, Frederick William,	M.E.,	Wilkes-Barre.
Sanborn, Robert Peirce,	E.M.,	Germantown.
Sanchez, Adolfo R.,	Chem.,	Camaguey, Cuba.
Sanderson, Percy,	B.A.,	Wyncote.
Sanford, Jesse Homer, jr.,	E.M.,	Carnegie.
Santry, John Joseph,	M.E.,	New Brighton, N. Y.
Sauber, Samuel Henry,	B.A.,	Allentown.
Scatko, Joseph John,	M.E.,	New Hartford, N. Y.
Schreiber, Frederic Donald,	Ch.E.,	Ocala, Fla.
Schrempel, Walter Adam,	C.E.,	South Bethlehem.
Shaffer, Thomas Graham,	M.E.,	Pittsfield, Mass.
Shoolbred, John, Jr.,	E.E.,	Baltimore, Md.
Siebert, Edward Clever,	C.E.,	Baltimore, Md.
Siegel, Alfred Ulman,	E.M.,	Salt Lake City, Utah.
Simpson, Gustavus Sailer,	C.E.,	Washington, D. C.
Sindel, LeRoy John Edward,	M.E.,	Reading.

Smith, Willard Kendall,	E.M.,	Philadelphia.
Snyder, Edward Beisel,	E.M.,	Hazleton.
Sterner, William Henry,	M.E.,	Richland Centre.
Street, Harvey Louis, 2d,	B.S.,	Brooklyn, N. Y.
Tapking, William Frederick, jr.,	C.E.,	Baltimore, Md.
Teeple, Perry McKee,	C.E.,	Glyndon, Md.
Thompson, Walter Walton,	E.E.,	Baltimore, Md.
Thornburg, Lewis,	C.E.,	South Bethlehem.
Tobias, Abraham,	E.E.,	Baltimore, Md.
Todd, William Booth,	E.E.,	Williamsport.
Turnbull, Lewis Ferdinand,	Chem.,	Baltimore, Md.
Van Sickle, Karl Gardner,	M.E.,	Olyphant.
Wagner, Clarence Reinoehl,	B.A.,	Lebanon.
Walker, Luther Sommer,	C.E.,	Woodstock, Va.
Wang, Hung Chueh,	E.E.,	Tientsin, China.
Ward, Arthur Thomas,	El.Met.,	Bellefonte.
Warrington, Chester Henry,	B.S.,	Washington, D. C.
Weber, George Hunt,	C.E.,	Washington, D. C.
White, Peter Joseph,	E.E.,	Johnstown.
Williams, Campbell Riley,	C.E.,	Washington, D. C.
Williams, Frank Carey,	C.E.,	Baltimore, Md.
Williamson, John Sheffield,	E.E.,	Baltimore, Md.
Wilson, Edmund Coxe,	E.E.,	St. Paul, Minn.
Wilson, Louis Earl,	C.E.,	Govans, Md.
Woelfel, Ralph Hartman,	C.E.,	Freeland.
Wolfe, George Fair,	C.E.,	Youngwood.
Wragg, Laishley Palmer,	B.S.,	Pittsburgh.
Yeh, Ting Shien,	E.E.,	Lealing, Hunan, China.
Zimmerman, Carl D.,	E.E.,	Buffalo, N. Y.

FRESHMAN CLASS.

CLASS OF 1915.

	Course.	Residence.
Albrecht, Joseph Wagner,	Chem.,	South Bethlehem.
Ambrose, Albert Justin,	C.E.,	Springfield, Mass.
Atkins, LeRoy Roberts,	C.E.,	Lebanon.
Baird, David Lamberton,	C.E.,	Freehold, N. J.
Baker, Joseph Wickersham,	E.M.,	Paterson, N. J.
Ballinger, Josiah Perkins,	C.E.,	Elizabeth, N. J.
Bast, Neil Jacob,	E.E.,	Allentown.
Bausman, John Myers,	M.E.,	Bausman.

Bennett, Joseph Smith, 3d,	M.E.,	Bethlehem.
Berg, Walter Philip,	M.E.,	Pittsburgh.
Bergstresser, Harold Frederick,	E.E.,	Emaus.
Blank, Albert Stein,	C.E.,	Allentown.
Bloede, Victor George, jr.,	B.S.,	Catonsville, Md.
Bodine, Alfred Van Sant,	M.E.,	Lambertville, N. J.
Bogert, Raymond Hirst,	E.M.,	Upper Montclair, N. J.
Borgman, Charles William,	B.S.,	New York, N. Y.
Bowman, John Best,	M.E.,	Mechanicsburg.
Boyd, Richard Noble,	Ch.E.,	Scranton.
Bradley, Herbert Earle,	E.E.,	West Haven, Conn.
Braun, John Henry,	E.E.,	Branford, Conn.
Brockman, Francis Comenius,	E.E.,	Nazareth.
Brown, Earl Haines,	B.A.,	Slatington.
Brown, Harold Augustus,	M.E.,	Carbondale.
Buck, Leonard Jerome,	E.M.,	South Bethlehem.
Butler, Clifton Linford,	C.E.,	Beach Haven, N. J.
Cahill, Daniel Russell,	C.E.,	South Bethlehem.
Cerdan, Adolfo Luis,	E.E.,	Jalapa, Mexico.
Chandler, Leigh,	B.S.,	Jersey City, N. J.
Chatfield, John Farquhar,	B.S.,	South Bethlehem.
Chewning, Garland Carpenter,	M.E.,	Richmond, Va.
Clark, Jewell Stanly,	C.E.,	Richland Centre.
Clinton, George Wilt, jr.,	B.S.,	Cumberland, British Columbia.
Collier, Robert Bell,	E.E.,	Paterson, N. J.
Connette, Thomas Wrenn,	C.E.,	Brooklyn, N. Y.
Cox, Donald Smyth,	M.E.,	Buffalo, N. Y.
Crichton, Harry A.,	B.S.,	Bethlehem.
Davidson, Delozier,	M.E.,	Elizabeth, N. J.
De Groot, Jarvis,	M.E.,	Catasauqua.
De Huff, Philip Greenawalt,	E.M.,	Lebanon.
De Laney, Thomas Joseph,	C.E.,	Wilkinsburg.
Della Valle, Emil Francis Humbert,	C.E.,	Bridgeport, Conn.
Dickey, Walter Cosgrove,	B.S.,	Houtzdale.
Dilcher, Harry James,	M.E.,	Allentown.
Dilley, Jesse Richard,	M.E.,	South Bethlehem.
Diven, Alexander Samuel, 3d,	C.E.,	Elmira, N. Y.
Dobbins, John Paul, jr.,	M.E.,	Trenton, N. J.
Downes, Joseph Watson,	B.S.,	Baltimore, Md.

Dunning, Norman,	E.M.,	Philadelphia.
Elder, George Reuben, jr.,	M.E.,	Easton.
Emmerich, Franz Josef,	B.S.,	Hazleton.
Ennis, Albert French,	Met.,	Catasauqua.
Epler, William Levi, jr.,	E.E.,	Baltimore, Md.
Eshbach, Ovid Wallace,	E.E.,	Pennsburg.
Esrey, William Hawkins, jr.,	El.Met.,	Atlantic City, N. J.
Evans, Josiah Lewis,	E.M.,	Johnstown.
Fairhurst, William,	M.E.,	Paterson, N. J.
Frey, Elmer Roy,	E.E.,	Coplay.
Geyer, Linwood Hirsch,	E.M.,	New York, N. Y.
Glass, Albert Frederick,	M.E.,	Milwaukee, Wis.
Glesmann, Louis George,	Ch.E.	Rome, N. Y.
Goldsmith, Wayne Alvin Eugene,	M.E.,	Catasauqua.
Grazier, Doré White,	E.E.,	Johnstown.
Green, Fred William,	M.E.,	Wilbraham, Mass.
Greenhalgh, James Thomas,	B.S.,	Catasauqua.
Hager, Otto Ernest,	C.E.,	Wilkes-Barre.
Harder, Julius Frederick,	C.E.,	Newark, N. J.
Hauser, John Flock,	B.S.,	White Haven.
Hazen, Edwin Ray,	B.S.,	Erie.
Higgins, Emerson Corson, jr.,	Chem.,	Bayonne, N. J.
Hiss, John Bosley,	C.E.,	Baltimore, Md.
Hubbard, Holland Amos,	B.A.,	Toledo, O.
Hukill, George Raymond,	C.E.,	Middletown, Del.
Humphrey, Effingham Perot,	M.E.,	Centralia.
Hussa, Leopold Richard,	E.M.,	Rockaway, N. J.
Ingram, Wharton Girard,	C.E.,	Philadelphia.
Keith, Elisha Boudinot,	B.A.,	New York, N. Y.
Kelchner, William Hayes,	C.E.,	New York, N. Y.
Kennedy, William, jr.,	C.E.,	Brooklyn, N. Y.
Kerbaugh, Joseph Fielding,	M.E.,	Bryn Mawr.
Keyes, Clarence Edward,	B.S.,	New York, N. Y.
Kirby, William Seth,	C.E.,	Oxford, Md.
Kline, Charles Wilson,	M.E.,	Palmerton.
Knight, Sam Young,	C.E.,	Washington, D. C.
Kurtz, Henry Keller, jr.,	B.A.,	Germantown.
Kutz, Ervin Swoyer,	E.E.,	Allentown.
Laird, Samuel Wilson,	C.E.,	Williamsport.
Lentz, Clarence Jerome,	Ch.E.,	Allentown.
Leslie, Lee Charles,	E.E.,	Sao Paulo, Brazil.

Linke, George Henry,	M.E.,	Plainfield, N. J.
Loo, Ming Ying,	Ch.E.,	China.
McFadden, Patrick Francis,	Chem.,	Allentown.
McGurl, Gilbert Vincent,	B.A.,	Minersville.
McKee, James Harper,	M.E.,	Catasauqua.
Madden, Franklin Hosea,	E.E.,	Tuckahoe, N. J.
Matheson, Niel Francis,	E.E.,	Middletown.
Mayforth, Harold Albert,	C.E.,	Springfield, Mass.
Merkel, Charles Elias,	B.S.,	Lyon Station.
Meschter, Jacob Funk,	Ch.E.,	East Greenville.
Metzger, Wellington,	E.E.,	Cumberland, Md.
Miller, August Henry,	M.E.,	Zanesville, O.
Miller, Jay C.,	M.E.,	Bangor.
Mills, Oscar E.,	E.E.,	Waynesboro.
Mitman, Samuel Thomas,	M.E.,	South Bethlehem.
More, William Stauffer,	B.S.,	Bethlehem.
Neide, Wilson Butler,	M.E.,	Philadelphia.
Nicholas, John Edward,	M.E.,	Eckley.
Norton, Percy Lamont,	E.M.,	Bristol, Conn.
Ospina, Pedro Nel, jr.,	E.M.,	Colombia.
Owen, Mark Nelson,	B.A.,	Hazleton.
Parodi, José Teobaldo,	M.E.,	Ayacucho, Peru.
Pazzetti, Vincent Joseph, jr.,	E.M.,	Wellesley Hills, Mass.
Pierson, Russell Mason,	C.E.,	Morristown, N. J.
Priestley, Thomas James,	C.E.,	Chicopee, Mass.
Prosser, Thomas Brown, jr.,	M.E.,	Philadelphia.
Pugh, Isaac William,	C.E.,	Oxford.
Purvis, Robert McBryde,	C.E.,	Lihue, Hawaii.
Raine, Joseph Willan,	E.M.,	Evenwood, W. Va.
Rank, Raymond Arthur,	E.M.,	Palmyra.
Read, Kenneth Hassler,	El.Met.,	East Orange, N. J.
Reisler, Evan Holmes,	C.E.,	Buffalo, N. Y.
Ritter, Charles Martin,	Chem.,	Allentown.
Roberts, Dudley Emerson,	E.M.,	Stamford, Conn.
Royall, Nelson McFaden,	Ch.E.,	Arcadia, Fla.
Schmutz, George Leroy,	El.Met.,	Somerset, Md.
Schuman, Karl George,	B.S.,	Newark, N. J.
Schuyler, Arent H.,	Met.,	New York, N. Y.
Search, Hendrick Monroe,	C.E.,	Philadelphia.
Shockley, Henry Wood,	M.E.,	Wilmington, Del.
Shoemaker, Harold Goodman,	B.S.,	Bridgeton, N. J.

Shoemaker, Ralph Emerson,	B.S.,	Bridgeton, N. J.
Shriver, Charles Mayer,	M.E.,	Baltimore, Md.
Sieger, Charles M.,	E.E.,	Coplay.
Smith, Harry Russel,	M.E.,	Shenandoah.
Snyder, Clarence Henry,	Ch.E.,	Pennsburg.
Solano, Edward,	M.E.,	Colombia.
Sproul, Richard Harrison,	C.E.,	Philadelphia.
Steele, Henry Carlton,	M.E.,	Palisade, N. J.
Stickel, William Augustus,	C.E.,	Newark, N. J.
Stuart, Homer Howland,	M.E.,	Fishkill-on-Hudson, N. Y.
Tanner, Charles Warner,	C.E.,	South Bethlehem.
Taylor, Samuel Paul,	B.A.,	Altoona.
Townsend, Louis Van Rensselaer,	Met.,	Negaunee, Mich.
Trexler, Hirst Mosser,	B.S.,	Allentown.
Trumbore, Clarence Weiss,	Chem.,	South Bethlehem.
Trumbower, Paul,	M.E.,	Passer.
Tull, Montrose Graham,	M.E.,	Philadelphia.
Uhl, Cecil Russell,	C.E.,	Mount Savage, Md.
Vance, Charles Fogle,	B.S.,	Winston-Salem, N. C.
Vanneman, Daniel Roland,	E.E.,	Havre de Grace, Md.
Vitzthum, Harry Louis,	E.E.,	Baltimore, Md.
Vogel, Harold Francis,	E.E.,	South Bethlehem.
Wagner, Carleton Schwab,	E.M.,	Philadelphia.
Ware, James Lawrence,	E.E.,	Drifton.
Weaver, Myron Alexander,	E.E.,	Centre Valley.
Western, Morris M.,	B.S.,	Detroit, Mich.
White, Milton Chase,	M.E.,	New York, N. Y.
Whiteman, Daniel Swab,	E.M.,	Philadelphia.
Wickersham, Robert Cadwalader,	E.E.,	Steelton.
Wickham, Irving Maurice,	E.E.,	Hartford, Conn.
Wiegand, August John,	E.M.,	Philadelphia.
Wilcox, Eugene Welcome, jr.,	B.S.,	Albion, N. Y.
Williams, Earle Cornelius,	E.E.,	Slatington.
Wolfe, Charles Abraham,	B.A.,	Allentown.
Wolfe, Harry,	B.S.,	Brooklyn, N. Y.
Wong, Chin,	Ch.E.,	Chekiang, China.
Wood, LeRoy Heinz,	B.S.,	Philadelphia.
Wood, Richard Francis,	C.E.,	Pelham, N. Y.
Wright, Lewis Augustus,	M.E.,	Kensington, Md.
Wuchter, Stanley Albert,	C.E.,	Allentown.
Zollinger, Edward Hanlen,	M.E.,	Harrisburg.

SPECIAL STUDENTS.

	Course.	Residence.
Greanoff, Albert Edward,	B.A.,	Bethlehem.
Houghton, Frederic Percy,	B.A.,	Jermyn.
Schumann, Donald Frederick,	B.A.,	Montclair, N. J.
Shimer, William Robert,	Met.,	Easton.
Weatherly, Ralph Armfield,	B.A.,	Marshall, N. C.
Williams, John Basil Percy,	B.A.,	South Bethlehem.

SUMMER SCHOOL STUDENTS.

(Whose names do not appear in the preceding lists but who attended Summer School only.)

	Course.	Residence.
Althenn, Henry John,	Chem.,	South Bethlehem.
Bolgiano, Clarence P.,	C.E.,	Baltimore, Md.
Bulley, Charles Reginald,	El.Met.,	Syracuse, N. Y.
Chin, Yushu,	E.E.,	China.
Davies, David,	E.M.,	Plymouth.
Downs, Nelson Miller, E.M., (*Lehigh University.*)	El.Met.,	Steelton.
Eberly, August Frederick, jr.,	El.Met.,	Washington, D. C.
Fatzinger, Robert Leroy,	Chem.,	Bethlehem.
Goundie, Joseph Kalbach,	E.M.,	Allentown.
Hesser, Albert Augustus, jr.,	C.E.,	Schuylkill Haven.
Hileman, William,	C.E.,	Buenos Aires, Argentine Republic.
Keiser, Raymond O'Donnell,	M.E.,	Altoona.
Miller, Harry Lou,	C.E.,	Kansas City, Mo.
Murphy, Caleb Temple,	E.E.,	Charlestown, W. Va.
Norwood, Aquila Rich,	E.E.,	Paterson, N. J.
Price, Samuel C.,	C.E.,	Hazleton.
Sterns, Morton William,	E.E.,	Bethlehem.
Thweatt, Carroll Philip,	C.E.,	Baltimore, Md.
Tremlett, James White,	E.M.,	San Antonio, Texas.
Tyler, John,	C.E.,	Williamsburg, Va.
Weil, Robert Preston,	Met.,	South Bethlehem.
Witherspoon, Paul Adams, B.E., (*Randolph-Macon College.*)	C.E.,	Woodstock, Va.

SUMMARY OF STUDENTS BY CLASSES AND COURSES.

	GRADUATES.	SENIORS.	JUNIORS.	SOPHOMORES.	FRESHMEN.	SPECIALS.	SUMMER SCHOOL STUDENTS.	TOTAL.
Arts & Science.	14	5	11	16	32	5		83
Civil Eng........	9	28	39	42	35		8	161
Mech. Eng......	7	17	26	36	41		1	128
Mining Eng....	5	11	26	21	17		3	83
Metal. Eng......	2	2	1	3	3	1	1	13
Electromet......		4	5	6	3		3	21
Electric. Eng...	7	26	9	32	26		4	104
Chemistry.......	2	3	7	5	5		2	24
Chem. Eng......		5	1	8	8			22
Totals.......	46	101	125	169	170	6	22	639

SUMMARY OF STUDENTS BY STATES.

Massachusetts	15
Rhode Island	4
Connecticut	10
New York	48
New Jersey	70
Pennsylvania	333
Delaware	5
Maryland	64
District of Columbia	14
Virginia	8
West Virginia	6
North Carolina	5
Georgia	1
Florida	2
Tennessee	1
Alabama	1
Mississippi	2
Ohio	4
Wisconsin	2
Michigan	4
Minnesota	1
Missouri	1
Texas	4
Colorado	2
Utah	1
California	1
Washington	2
Hawaii	1
Canada	1
Mexico	3
Cuba	5
Nicaragua	1
Colombia	3
Costa Rica	1
Ecuador	1
Peru	1
Argentine Republic	1
Brazil	1
China	8
Syria	1
	639

STUDENTS IN TEACHERS' COURSES.

The following are names of students, principally teachers in the local high schools, who have taken studies in the Saturday Teachers' Courses under the direction of members of the teaching staff of the University. They are not matriculated students of the University. These Courses for Teachers are explained on page 112.

Allen, Mary G.,	Allentown.
Balliet, Clara M.,	Allentown.
Bickel, Edward O., B.S.,	Bethlehem.
Boone, Florence Elizabeth,	South Bethlehem.
Busse, Laura E.,	Allentown.
Caldwell, Ralph G., B.A.,	Bethlehem.
Cope, Mrs. A. L.,	South Bethlehem.
Dow, Edna Ella,	Bethlehem.
Erdman, Ella,	Allentown.
Frankenfield, Ira M.,	Coopersburg.
Fuerstenow, S. Anna,	South Bethlehem.
Griffith, Sallie,	Allentown.
Heckrotte, Sallie,	Allentown.
Hess, Mary Lucetta,	Hellertown.
Himmelreich, Walter F.,	Hellertown.
Kichline, Carrie B.,	Allentown.
Kistler, Alla P.,	Allentown.
Killough, Maria Wilhelm,	Bethlehem.
Koons, Carrie E.,	Allentown.
Kratz, Sarah E.,	Allentown.
Kunkle, G. B., A.B.,	Wind Gap.
La Barre, Mildred, A.B.,	Easton.
Landis, Robert C.,	Hellertown.
Leiby, Mary,	Allentown.
Lord, Elvira May,	Bethlehem.
Marsteller, Helen May,	South Bethlehem.
Murray, Annie Victoria,	Bethlehem.
Nolfe, Laura Attala,	Bethlehem.
Nonnemacher, Emma A.,	Allentown.
Platt, James E., B.S.,	South Bethlehem.
Richards, Cora Alice,	Maxatawney.
Roth, Lillie H.,	Allentown.

Roth, Mary,	Allentown.
Schmerker, Charlotte S.,	Allentown.
Sassaman, Clara,	South Bethlehem.
Shelling, E. Ruth,	Allentown.
Snyder, Laura V.,	Allentown.
Souder, Agnes Ida,	Catasauqua.
Spatz, Margaret,	Allentown.
Thomas, Ruth Groman,	Bingen.
Walters, Wilburt Robert, B.A.,	Bethlehem.

ALUMNI

OF

LEHIGH UNIVERSITY.

[An Employment Bureau for Lehigh University graduates is maintained by the Alumni Association.]

CLASS OF 1869.

*Corbin, J. Haynes Hinds, A.C.

*Rock, Miles, C.E.

*Ronaldson, Charles Edward, B.A. (Univ. of Pa., '68), M.E.

CLASS OF 1870.

*Ashmead, Lehman Preston, A.C., M.D.

*Brodhead, Richard, M.E.

Butler, William Richards, M.E., Manufacturer, Mauch Chunk, Pa. Res: 8th & Centre Sts., East Mauch Chunk, Pa.

*Jenkins, George A., A.C.

Kerr, William J., A.C., M.E.

*Packer, Harry E., A.C.

Price, Henry R., C.E., M.D., Physician, 435 Clinton Ave., Brooklyn, N. Y.

Reed, Henry Bidlack, B.A., M.D., Physician (retired), Milford, Pa.

*Ronaldson, William Dunlop, B.A., M.D.

*Thome, John M., C.E., Ph.D.

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1906.

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1907.

HAMERSCHLAG, ARTHUR ARTON, Sc.D. (Honorary), Director, Carnegie Technical Schools, Pittsburgh, Pa. Res: 4040 Grant Boul.

STILLWELL, LEWIS BUCKLEY, M.S. (Honorary), Consulting Eng'r, 100 Broadway, New York, N. Y.

1908.

PARSHALL, HORACE FIELD, M.S. (Honorary), Consulting Eng'r, 801 Salisbury House, London Wall, London, E. C., England.

1909.

SPARKS, EDWIN ERLE, Ph.D., LL.D. (Honorary), President, Pennsylvania State College, State College, Pa.

WICKERSHAM, GEORGE W., A.M., LL.D. (Honorary), Attorney General of the United States, Washington, D. C.

The number of graduates is 2183, degrees having been conferred as follows:

Upon graduates of the Department of Arts and Science: B.A., 119; B.S., 26; Ph.B., 7; M.A., 21.

Upon graduates of the Departments of Technology: C.E., 715; M.E., 515; B.M., 19; B.S. (in Mining and Metallurgy), 114; B.S. (in Chemistry), 13; E.M., 202; E.E., 306; A.C., 132; B.S. (in Architecture), 16; Met.E., 17; El.Met., 22; Chem.E., 18; M.S., 29; Ph.D., 2.

Honorary degrees: LL.D., 3; Sc.D., 1; M.S., 2.

Of these 20 have taken the degree of B.A. and M.A.; 5 of B.S. and C.E.; 2 of B.A. and C.E.; 1 of B.A. and M.E.; 1 of B.A. and E.M.; 1 of B.S. and A.C.; 10 of B.M. and E.M.; 49 of B.S. and E.M.; 1 of B.S., B.M. and E.M.; 1 of B.M., E.M., and A.C.; 1 of B.S., E.M., and C.E.; 1 of C.E. and E.M.; 2 of A.C. and E.M.; 1 of C.E. and M.E.; 1 of M.E. and B.S.; 3 of M.E. and E.E.; 1 of E.M. and E.E.; 1 of E.M. and El.Met.; 4 of B.S. and M.S.; 7 of C.E. and M.S.; 3 of E.E. and M.S.; 1 of M.E. and M.S.; 3 of A.C. and M.S.; 1 of Met.E. and M.S.; 1 of B.S., E.M. and M.S.; 2 of A.C., M.S., and Ph.D. 2034 graduates are living.

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Beginning with the year 1884-85, the University offered a special course in Electricity, covering one year's work. Those who completed this course received certificates, but no degrees. In 1888, the full four-year course in Physics and Electrical Engineering, leading to the degree of E.E., was established, and the one-year course was withdrawn. The names of those who completed this course are not included in the Roll of Alumni, but are here given:

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Balston, A. P., '08.
Balston, H. P., '08.
Banks, C. L., '88.
Banks, H. C., '93.
Banks, N. C., '93.
Banks, W. F., '09.
Bannon, A. F., jr., '95.
Barager, G. W., '00.
Barba, C. E., '01.
Barber, J. C., '95.
Barker, J. S., '09.
Barley, W. S., '05.
Barnard, H. P., '04.
Barnard, R. P., '89.
Barnes, W. M. D., '06.
*Barr, J. N., '71.
Barrell, J., '92.
Barrell, R. W., '87.
Barrett, F. R., '90.
Barrientos, A. D., '98.
*Barry, D. M., '01.
Barth, C. G., jr., '08.
Bartholomew, G. W. P., '96.
Bartholomew, R. J., '95.
Bartles, F. R., '96.
Barton, C. M., '97.
Barwis, C. W., '06.
Bason, G. O., '09.
*Bassell, J. Y., jr., '92.
Bassler, H., '08.
Bastress, J. N., '92.
Bastress, R. C., '95.
Bates, A. H., '89.
*Bates, E. A., '88.
Baton, G. W. S., '94.
Bauder, C. C. W., '96.
Baughman, J. H., '10.
Baumgartner, C. G., '04.
Baumgartner, E. F., '11.
Bayard, A. W., '00.
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Bayard, R. A., '07.
Bayles, H. G., '04.
Bayless, J. S., '09.
Beach, H. W., '95.
Beato, E., '08.
*Beatty, W. D., '88.
Beaumont, J. M., '92.
Beaver, J. L., '04.
Beazell, E. H., '90.
Becerra, R. C., jr., '99.
*Bechdolt, C. J., '75.
Bechhoefer, C. H., '10.
Bechtel, F. V., '09.
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Beck, G. C., '03.
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Beggs, G. W., jr., '95.
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Beitzel, T. O., '10.
Belden, E. T., '96.
Bell, F. B., '98.
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Bellis, A. P. S., '09.
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Berg, J. D., '05.
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Best, J. H., '95.

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Birely, L. S., '06.
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Bricker, C. S., '95.
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Brindle, R. G., '07.
Brink, L. C., '94.
Brinsmade, R. B., '95.
Broadbent, W. W., '10.
Brodhead, J. A., '07.
*Brodhead, R., '70.
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Brothers, G. R., '08.
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Browning, F. H., '05.
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Bruner, A., '80.
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Buch, J. A., '06.
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Byers, M. L., '88.

C

Caldwell, H. W., '08.
Callaghan, J. T., jr., '95.
Callen, A. C., '09.
Campbell, E., '89.
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Capriles, J. F., '99.
Cardenas, A., '90.
Carlock, J. B., '07.
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Carrier, L. R., '10.
Carrington, M., '96.
Carroll, T. F., '94.
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*Carson, J. D., '76.
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Case, C. M., '92.
Case, G. P., '92.
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Cassin, W. D., '06.
Castellanos, C., '03.
Castleman, F. L., '95.
Caum, S. L., '04.
Chamberlain, G. E., '93.
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Chamberlain, M., '00.
Chao, E., '91.
Chapin, C. H., '11.
Chapman, H. B., '00.
Chapman, N., '05.
Charles, R. L., '07.
Chase, M. H., '06.
Chester, H. W., '89.
Chetwood, R. E., jr., '95.
Childs, D. H., '98.
Chiles, S. W., '97.
Church, H. A., '05.
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*Clapp, C. E., '86.
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Cleaveland, H. B., '04.
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Coates, F. R., '90.
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Cobb, P. L., '92.
Coleman, F. A., '92.
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Collins, F. A., jr., '08.
Connard, G. P., '88.
Conover, E. M., '11.
Conrad, L. E., '08.
Converse, B. T., '99.
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Cope, W. S., '90.
*Coppée, H. St. L., '72.
*Corbin, J. H. H., '69.
Corbin, J. R. N., '09.
Corbin, W., '89.
Corddry, W. H., '11.
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Cornwell, B. A., '04.
Corsa, D., '05.
Cort, J. J., '03.
Cort, S. J., '06.
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Couch, F. F., '09.
Coutant, G. C., '00.
Cowgill, C. S., '09.
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*Crane, J. H., '01.
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Craver, G. C., '11.
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Cressman, H. M. S., '95.
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Cresson, W., '91.
Crilly, A. P., '81.
*Crilly, F. J., '83.
Crocker, G. H., '10.
Croll, J. P., '99.
Croll, S. W., jr., '10.
Crowther, J. S., jr., '06.
Crump, R. F., '11.
Cuesta, L., '04.

Cullen, R. E., '07.
Cullum, J. B., '90.
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*Curtis, B. O., '97.
Curtis, C. S., '03.
Curtis, S. P., '96.
Cushing, S. D., '92.

D

Daboll, F. A., '96.
Daggett, H. M., '98.
Dailey, E. J., jr., '10.
Dalman, J. W., '96.
Dalrymple, F. W., '83.
Dandois, C. S., '08.
Daniel, J. M., jr., '02.
Daniels, C. M., '07.
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Daniels, R., '88.
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Daugherty, H. B., '06.
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Davis, M., jr., '92.
Davis, W. R., '92.
Davis, W. S., '88.
Dawson, J. R., '11.
Dayett, G. H., '09.
Dean, D. K., '06.
Dean, W. H., '86.
*Deans, C. H., '89.
DeBaufre, W. L., '07.
Dech, W. J., '93.
Deck, H. S., '95.
Deemer, F. J., jr., '08.
Degener, P. A., '03.
Degener, R., '99.
*Degenhart, F. R. C., '72.
Dehm, W. A., '98.
*DeHuff, A. S., '07.
DeHuff, H., '95.
DeMoyer, J. W., '90.
Denise, C. M., '98.
Denlinger, C., '06.
Denman, H., '92.
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Dent, H. C., '06.
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Desh, R. J., '09.
Dessauer, S. M., '96.
*Detwiler, C. H., '90.
*Devine, J. J., '09.
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DeWitt, S. C., '95.
Dey, W., '09.
Dick, J. C., '95.
Dickerman, W. C., '96.
Dickerson, C. E., '89.
Diebitsch, E., '89.
Diefenderfer, A. A., '02.
Diefenderfer, A. J., '03.
Dietrich, W. C., '09.
Dilliard, H. C., '00.
Dinan, P. E., '97.
Distler, J. C., '06.
Diven, A. B., '94.
*Diven, E., '87.
Diven, L., '97.
Doak, S. E., '07.
Dobson, W. T., jr., '10.
Dodds, F. L., jr., '10.
Dodge, E., '92.

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Domenech, M. V., '88.
Donahoe, T. J., '83.
Donaldson, F., '01.
Donaldson, W. M., '08.
Donegan, J. J., '08.
Donkel, W. J., '10.
Doolittle, A., '87.
Doolittle, E., '91.
Dornin, A. L., '04.
Dorrance, C., '07.
Dorsey, C. H., '08.
Dorsey, J. W., jr., '08.
Dougherty, J. W., '89.
Douglas, C. M., '93.
Douglas, H. B., '84.
Douglas, W. J., '94.
Dowling, R. D. T., '09.
Downey, J. N., '02.
Downs, C. L., '10.
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Drake, B. I., '97.
Drake, W. T., '00.
Draper, W. A., '07.
Dravo, F. R., '87.
Dravo, G. P., '88.
Dravo, R. M., '89.
Drayton, P., '92.
Drinker, H. S., '71.
Droll, E. A., '05.
Drummond, R. S., '06.
DuBarry, B., jr., '95.
Duck, G. F., '83.
Dufour, F. O., '96.
Dunbar, W. E., '04.
Duncan, M. M., '80.
Duncan, W. C., '08.
Dunn, G. A., '07.
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Dunstan, H. A., '11.
Durfee, C. H., '93.
Durham, E. M., jr., '96.
Dutcher, E. H., jr., '96.
DuVivier, E. H. J., '89.
Dyer, R. F., '10.
Dynan, J. L., '09.
Dyson, H. P., '07.

E

Eagley, J., '77.
Earnshaw, W. A., '09.
Eastman, C. L., '07.
Eavenson, A., '91.
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Empie, T. G., '94.
Engel, G. W., '92.
*Engelbert, J. R., '85.

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Enright, B., '93.
Enscoe, G. R., '96.
Enzian, C., '01.
Escobar, J. de la C., '91.
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F

Fair, J. M., '08.
*Faison, E. L., jr., '95.
Farabaugh, A. J., '04.
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*Farwell, W. D., '89.
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*Frederick, T. W., '76.
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Fusselman, P. A., '08.

G

*Gabrio, G. L., '95.
Gadd, L. L., '94.
Gadd, R. F., '93.
Galán, A. G., '95.
Galán, J. M. G., '98.
Galbraith, F. E., '11.
Gallardo, C., '02.
Gallardo, F. M., '97.
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Gates, W., jr., '88.
Gaumer, A. W., '06.
*Gavan, J. T., '02.
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Genó, J. R., '09.
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*Glassel, A. M., '77.
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*Glover, J. B., jr., '88.
Godshalk, E. G., '95.
Godshall, H. H., '93.
Goeppert, G. E., '11.
Goerlich, R. S., '05.

Gohl, E. F., '07.
Goldschmidt, S. W., '03.
Goldsmith, N. O., '83.
Golian, F. E., '02.
Gonzales, C., jr., '10.
Good, M., '11.
Good, O. S., '97.
Goodman, R., '90.
Goodnow, W. T., '83.
Goodwin, G. K., '04.
Gorman, J. C., jr., '10.
Goss, W. R., '95.
Gossling, T. L., '06.
Gosztonyi, C. A., '10.
Gott, E. T., '06.
Gotwald, R. C., '86.
Goytisolo, A. A., '08.
Grabbe, J. J., '04.
Grace, E. G., '99.
Grace, J. W., jr., '99.
Gradwohl, C. A., '02.
Grady, W. H., '06.
*Graff, J. S., '96.
Graff, M. B., '94.
Graff, W. W., '01.
Graham, C. B., '03.
Graham, O. L. J., '11.
Graham, S. L., '93.
Grammer, F. L., '89.
Gratz, W., '98.
Gray, C. W., '81.
Graybill, J. H., '11.
Green, R. J., '07.
Greene, A. E., '06.
Greene, G. E., '90.
Greene, H. T., '00.
Greenough, L. C. D., '09.
Greenough, M. J., '07.
Gregg, J. H. C., '06.
Gressitt, J. L., '08.
Griffen, J., '11.
Griffith, W., '76.
Griggs, J. S., jr., '91.
Grimball, W. H., '06.
Grissinger, E. A., '94.
Griswold, R. S., '97.
Groeninger, H. J., '07.
Groff, F. A., '00.
Gross, Charles Aaron, '07.
Gross, Charles Augustus, '10.
Gross, C. F., '00.
Gross, R. F., '02.
Grossart, L. J. H., '86.
Groverman, W. H., '96.
Grubb, P. L., '01.
Grubbe, W. B., '00.
Gruber, H. D., '09.
Grubmeyer, A. B., '07.
*Gruver, J. A., '92.
Guerber, A. J., '08.
Guerber, R. S. S., '06.
Gummere, W., '99.
Gunsolus, F. H., '98.
Guthrie, B., '94.

H

Haas, H. A., '11.
Haas, W. N., '01.
Hachita, M. S., '02.
Hafner, A. H., '08.
Hagenbuch, C. C., '09.
Hagy, C. B., '06.
Hain, G. W., '09.
Haines, C. W., '74.
Haines, F. T., '95.
*Haines, H. S., '87.
Halbach, J. G., '75.
Haldeman, B. F., '81.
Hall, D., '96.
Hall, J. R., '10.
Hall, W. M., '94.
Hall, W. R., '02.
Haller, O. J., '04.
Hallock, F. D., '94.

Haltermann, F. W., '10.
Hamerschlag, A. A., '07 (Hon.).
Hamilton, T. G., '95.
Hanauer, M. S., '86.
Hanly, W. T., '97.
Hanna, W. S., '02.
*Hannum, O. C., '99.
Hanscom, A. B., '00.
Hanst, J. F., '07.
Hardcastle, H., '88.
Hardcastle, T. H., '80.
Hardcastle, Y. F., '06.
Hare, W. G., '98.
Harleman, S. T., '01.
Harley, H. W., '90.
Harper, H. T., '84.
Harrar, E. S., '01.
Harris, G. W., '89.
Harris, L. S., '93.
Harrison, N. C., '05.
Harrower, R. A., '05.
Hart, G. A., '88.
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Hartshorne, W. D., '74.
Hartzog, H. J., '04.
Harvey, H. G., '09.
Harvey, R. R., '95.
Harwi, S. J., '86.
Hasek, C. W., '11.
Hasler, H. H., '09.
Hatter, R. C., '08.
*Hausman, F. A., '01.
Havenstein, P. W., '09.
Hayes, C. D., '05.
Hayes, E. P., '06.
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Heard, R. W., '93.
Hearne, D. G., '90.
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Heck, L., '08.
Heck, N. H., '03.
Heck, R. C. H., '93.
Hegeman, J. S., '02.
Heikes, I. A., '85.
Heilig, J. S., '91.
Heilman, C. G., '10.
Heilman, J. C., '09.
Heim, W. L., '02.
Heindle, W. A., '91.
Heinz, J. G., '00.
Hellen, C. J., '11.
Heller, G. M., '77.
Heller, R. P., '09.
Henderson, L., '89.
*Henderson, W. H., '05.
Hendricks, W. H., '06.
Henry, F. A., '06.
Henry, T. L., '95.
Henry, W. E., '10.
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Heritage, C. S., '04.
Herman, P. H., '06.
Herr, A. A., '74.
Herr, H. N., '96.
Herrick, R. L., '04.
Herrmann, W. S., '11.
Hersh, J. F., '91.
Hershey, H. B., '98.
Hertzler, J. W., '03.
Herzog, G. K., '07.
Hess, H. D., '96.
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*Hess, H. S., '95.
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*Hesse, C. E., '89.
Hesse, H. V., '91.
Hewett, D. F., '02.
Hiester, W. S., '97.
Higbee, I. M., '95.
Higgins, E., jr., '02.
Hill, S. W., '08.
Hillegas, H. H., '84.
Hilliard, F. H., '94.
Hillman, E. D., '98.
Hills, J. H., '08.
Hiney, H. F., '10.
*Hinkle, C. F., jr., '03.
Hirst, J. B., '04.
Hiss, W. J., jr., '95.
Hittell, J. B. F., '87.
Hodges, S. H., '04.
Hodgkin, R. G., '05.
Hoeke, H. W., '05.
Hoffman, J. D., '83.
Hofford, E. F., '84.
Hohl, A. K., '11.
Holcombe, W. E., '94.
Hollingsworth, A. D., '00.
*Hollinshead, J. S. B., '90.
Hollister, J. F., '09.
Holz, M. H., '94.
Honan, M. J., '00.
Honeyman, P. D., '91.
Honeyman, R. B., '88.
Hood, G. G., '83.
Hood, R. N., '97.
Hooke, R. A., '07.
Hoover, J. T., '91.
Hopkins, C. C., '82.
Hopkins, W., '95.
*Hoppes, G. L., '83.
Hoppin, G. H., '08.
Hoppock, C. A., '09.
Horcasitas, D., jr., '11.
Horn, H. J., '98.
Horne, F. R., '07.
Horne, G. A., '99.
Horner, G. R., '11.
Horner, L. S., '98.
Hornor, R. R., '99.
Hostetter, E. B., '05.
Houck, J. E., '10.
Houskeeper, H. S., '72.
*Houston, F. K., '90.
Howard, J. M., '87.
Howard, O. Z., '07.
Howe, F. P., '78.
Howe, M. A. deW., '86.
Howell, R. P., '96.
Howitz, A. A., '94.
Hu, H. T., '11.
Huang, S. K., '11.
Hudson, C. W., '89.
Huggins, E. M., '00.
Hulse, E. P., '07.
*Humphreys, J. E., '06.
Hunsicker, G. W., '94.
Hunt, A. E., '11.
Hunt, R., '03.
Hunter, D. H., '11.
Hurst, F. G., '07.
Hutchinson, A. C., '02.
Hutchinson, G. C., '94.
Hutchinson, R. P., '04.

I

Ichikawa, H., '91.
*Irvine, D. W., '95.
Irwin, H. T., '97.
Isert, J. G. H., '05.

J

Jackson, G. R., '99.
Jackson, H. J., '08.
Jackson, H. L., '04.
Jackson, W. C., '10.
Jackson, W. S., '96.
Jacob, H. R., '10.

Jacobosky, G. G., '07.
Jacobs, C. B., '95.
Jacobs, M. L., '10.
Jacoby, C. A., '06.
Jacoby, E. A., '95.
Jacoby, F. W., '10.
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Jacoby, W. L., '92.
Jahne, J. F., '10.
James, J. R., '06.
James, R. L., '08.
James, W. A., '95.
Janeway, L. W., '08.
Jannus, R. W., '11.
Jardine, D. W., '07.
Jardine, J. A., '84.
Jaudon, H. S., '95.
Jaxheimer, W. H., '02.
Jefferson, F. W., '06.
Jencks, S. H., '88.
*Jenkins, G. A., '70.
Jenks, A. P., '97.
Jennings, C. H., '09.
Jessup, A. B., '95.
*Jessup, A. E., '92.
Jeter, J. T., '80.
Jiminez, J. J., '92.
John, E. B., '95.
Johns, W. S., jr., '02.
Johnson, A. T., '99.
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Johnson, N. L., '09.
Johnson, P. K., '10.
Johnson, R. G., '04.
Johnson, V. A., '96.
Johnston, A., '89.
Johnston, E. E., '06.
Jones, A. B., '94.
Jones, B. H., '94.
Jones, C. C., '87.
Jones, H. H., '97.
Jones, J. T., '05.
Jones, M. D., '05.
Jones, R. H., '07.
Jordan, H. E., '03.
Jordan, W. R., '03.
Juhler, A. E., '91.
Jump, E. P., '01.
Junken, C. A., '86.

K

Kappella, A. S., '95.
Kauffman, P. D., '08.
Kaufmann, H. J., '10.
Kautz, D., '95.
Kautz, R. C., '05.
Kavanaugh, R. D., '04.
Kavanaugh, W. H., '94.
Keck, M. A., '04.
Keefe, D. C., '11.
Keife, C. F., '09.
Keife, H. N., '09.
Keim, W. B., '95.
Keiser, R. O., '11.
Keller, C. L., '93.
Kellogg, J. S., jr., '89.
Kellogg, J. W., '84.
Kemmer, F. R., '10.
Kemmerling, H., '91.
Kempsmith, R. M., '11.
Kendig, C. E., '02.
Kennedy, F. U., '07.
Kenney, C. S., '10.
Kent, B. M., '04.
Kent, G. E., '07.
Kent, H. O., '09.
Kerlin, J. M. S., '89.
Kerr, D. G., '84.
Kerr, H. D., '11.
Kerr, W. J., '70.
Ketcham, H. H., '09.
Keys, E. A., '99.

Kiefer, H. E., '92.
Kiesel, J. S., '11.
Kiesel, W. F., jr., '87.
Killough, E. M., '10.
Kimball, E. N., '08.
Kimball, R., '99.
King, C. F., '80.
King, E. G., '07.
King, T., '08.
Kinsey, R. W., '07.
Kip, H. E., '95.
Kirk, M. D., '06.
Kirk, R. G., '05.
Kitchel, R. R., '92.
Kittrell, J. W., '87.
Klar, R. L., '09.
Klein, A. W., '99.
Klinck, J. H., '99.
Kline, V. W., '96.
Kline, W. C., '05.
*Klotz, L. E., '72.
Knapp, H. M., '91.
Knauss, J. O., '10.
Kneas, F. N., '98.
Knight, R. W., '94.
Knorr, F. H., '87.
Knox, S. B., '93.
Koch, C., '11.
Koch, H. O., '05.
Koch, S. B., '08.
Kodjbanoff, B. G., '98.
Komara, J. J., '08.
Koplin, R. D., '10.
Kops, J. deB., '83.
Kotz, T. F., '08.
Kraemer, F. J., '08.
Kraemer, T. C., '11.
Krause, A. E., '08.
Krause, J. B., '98.
Krause, L. G., '01.
Krause, P. T., '04.
Kresge, R. E., '96.
Kriebel, C. T., '07.
Kring, S. L., '11.
Kulp, W. V., '90.
Kurtz, H. M., '90.
Kuryla, M. H., '05.
Kynor, H. D., '10.

L

Labrot, S. W., '92.
Lacey, T. N., '06.
Lackey, D. H., '95.
Lafferrander, R. L., '07.
Lafon, N., '78.
Lakey, A. B., '08.
Lambert, P. A., '83.
Lambert, S. E., '89.
Lambert, W. A., '95.
Lance, O. M., '72.
Landis, H. K., '90.
Landis, K., '08.
Landis, W. S., '02.
Landron, R. S., '99.
Langdon, C. A., '94.
*Langdon, S. D., '87.
Langston, F. B., '84.
Langston, W., '84.
Langstroth, C. B., '08.
Lanier, S. S., jr., '10.
Lannan, L. E., '95.
Lantz, W. F., '10.
de Lara, G. L., '86.
Laramy, R. E., '96.
Larkin, W. H., jr., '05.
Lathrop, W. A., '75.
Laubach, S. T., '01.
Laubenstein, A. R., '01.
Lauderburn, F. C., '91.
Lauer, H. H., '06.
Lawall, E. H., '82.
Lawrance, J. P. S., '73.
Lawrence, L., '10.
Lawrence, T. H., '98.

Lawson, A. W., '07.
Lawton, F. T., '09.
Lay, I. L., '10.
Layman, H. Q., '05.
Leaman, C. H., '08.
Ledoux, J. W., '87.
Lee, H. R., '06.
Lee, L. R., '97.
Lefevre, H., '92.
Leibfried, J. E., '00.
Leidy, G. C., '00.
Leilich, F. T., '08.
Leonard, J. F., '05.
Leopold, H. D., '94.
Leoser, C. M., '91.
*Leoser, T. S., '90.
*Lesher, T. M., '07.
Lesser, W. H., '05.
Lessig, W. G., '00.
LeVan, L. A., '10.
Lewis, A. E., jr., '88.
Lewis, A. H., '95.
Lewis, G., '95.
Lewis, G. M., '03.
Lewis, H. S., '00.
Lewis, T., '97.
Lewis, W., '10.
Lincoln, C. F., '11.
Lincoln, J. J., '89.
Linderman, G. B., '87.
*Linderman, R. P., '84.
Lindsey, J. B., jr., '98.
Lines, F. F., '02.
Linn, W. A., '04.
Lister, A. E., '92.
Litch, J. E., '90.
Littell, F. J., '99.
Little, J. E., '94.
Livesay, H. G., '10.
Livingston, C. V., '97.
Lloyd, W. J., '92.
Lockett, J., '89.
Loeb, B. W., '95.
Loeb, F. S., '93.
Long, A., '89.
Loomis, A. F., '97.
Loomis, B. E., '96.
Loomis, C. A., '98.
Loomis, J. T., '92.
Loose, J. G., '07.
Loper, R. E., '08.
López, P. N., '11.
Lord, C. G., '03.
Lord, C. W., '96.
Lores, J., '09.
Lotz, C. W., '06.
Loucks, C. M., '07.
Lovering, T. P., '95.
Lowengrund, A. J., '08.
Lowry, D. R., '11.
Luch, M. J., '02.
Luckenbach, C. A., '86.
*Luckenbach, C. O., '94.
Luckenbach, O. F., '01.
Luckie, J. B., '09.
Lüders, C. W., '04.
Lüders, T. H., '06.
Lukens, T. W., '00.
Lull, C. E. T., '00.
Lydon, W. A., '86.
Lynch, J. P., '08.
Lynch, W. H., jr., '05.
Lytle, W. T., '08.

M

MacCalla, C. S., '96.
MacCart, W. T., '04.
*MacCarthy, W H.., '71.
MacFarlane, W. C., '04.
MacKnight, O. G., '99.
MacMinn, R., '07.
MacNutt, B., '97.
McBride, J. B., '96.
McCann, W. E., '08.

McCarthy, W. T., '00.
McCaskey, H. D., '93.
McCauley, L. G., '04.
McClain, J. F., '10.
McCleary, J., jr., '04.
McClintic, H. H., '88.
*McClung, M., jr., '94.
McClurg, J. A., '91.
McComas, K. W., '00.
McDevitt, F. J., '04.
McElfresh, R. F., '08.
McEntire, L., '09.
McFarland, W. A., '88.
McGonigle, C. J., '01.
McGunnegle, G. K., '99.
McIlvain, H. L., '88.
McIntosh, H. A., '07.
McKee, R. A., '95.
McKenzie, C. L., '93.
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*McKenzie, S. T., '95.
McMullen, R. S., '06.
McMurtrie, A. J., '09.
McNally, E. M., '07.
McNiff, G. P., '06.
McPherson, J. D., '94.
McQueen, P. O., '07.
McVey, J., '02.
McVey, J. T., '06.
*McVey, W. G., '00.
Macfarlane, C. W., '76.
Macfarlane, E., '08.
Mack, E. M., '04.
Mack, J. S., '88.
Mackall, R. U. P., '07.
Mackie, W. F., '08.
Maddock, H. E., '09.
Maeder, C. E., '00.
Maeder, W. A., '09.
Mahon, R. W., '76.
Malcher, J. J. daG., '76.
Manley, H. L., '92.
March, P. D., '06.
Marks, C. E., '03.
Marr, W. P., '93.
Marshall, C. D., '88.
Marshall, H. C., '06.
Marshall, L. H., '98.
Marsteller, J. F., '77.
Martenis, J. V., '94.
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Martin, J. P., '00.
Martin, W., '05.
Martinez, C. E., '01.
Mason, J. G., '97.
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Maurer, D. A., '06.
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Mawhinney, T. A. H., '06.
May, S., '10.
Mayer, A. J., '07.
Meaker, A. E., '75.
Meaker, W. L., '99.
Mease, J. A., '05.
Megraw, W. A., '97.
Meily, H. S., '87.
Mendoza, J. M., '06.
Menough, L. D., '01.
Mercader, L., '06.
Mercenario, E. A., '97.
Mercur, R. A., jr., '07.
Merkel, W. L., '11.
*Merkle, J. F., '84.
Merrick, F. A., '91.
*Merrill, W. S., '94.

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*Merritt, T., '74.
Mervine, E. M., '09.
Mervine, G. S., '05.
Messinger, C. C., '11.
Meyers, W. R., '07.
Mickley, T. B., '05.
Middledith, J. F., '99.
Miles, R. P., '08.
Milheim, E. M., '02.
Mill, E. D., '09.
Millar, E. J., '92.
Miller, Charles Henry, '88.
*Miller, Charles Henry, '89.
Miller, Charles Herbert, '90.
Miller, E. F., '83.
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Miller, R. N., '08.
Miller, W. H., '94.
*Millholland, J. H., '88.
Millholland, P. D., '86.
Mills, K., '06.
Miner, H. S., '88.
de Miranda, H. B., '73.
de Miranda, R. F., '72.
Mitman, C. W., '09.
*Miyahara, S., '77.
Moffatt, C. L., '04.
Moffett, C. W., '89.
Mohr, W. H., '11.
Moncrieff, V. I., '10.
Moore, A. W., '06.
Moore, C. A., '94.
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Moore, L. A., '07.
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de la Mora, M., '00.
de la Mora, R., '96.
More, R. P., '10.
More, W. F., '83.
Morgan, C. H., '96.
Morgan, E. L., '11.
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Morgan, T. A., '04.
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*Moritz, C. F., '98.
Morris, A. D., '95.
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Morsack, C., '08.
Morss, B. G., '09.
Morss, C. R., '04.
Morss, L. M., '04.
Mosher, J. L., '10.
Mosman, C. T., '92.
Mosquera, L., jr., '08.
Mott, D. L., '88.
Mount, F. D., '97.
Müller, F. R., '09.
Murnane, G. F., '10.
Murphy, E. T., '01.

Murphy, H. M. P., '04.
Murray, A. F., '05.
Murray, C. E. P., '02.
Murray, W. S., '95.
Mussey, W. H., '96.
Mussina, W. U., '04.
Myers, H. K., '84.
Myers, J. H., '96.
Myers, L. B., '07.
Myers, W. H., '03.
Mylander, W. F., '93.

N

Nachod, C. P., '97.
Nagel, F. T., '08.
Nauman, G., jr., '90.
Neill, W. L., '88.
*Neilson, R., jr., '95.
Neiman, H. S., '88.
Neufeld, J. L., '94.
Neuffer, C. W. F., '94.
Neumeyer, R. E., '90.
Newbaker, C. A., '94.
Newton, C. G., '99.
*Newton, H. H., '97.
Nicholson, D. K., '85.
Nicholson, T., '83.
Nicholson, W. E., '07.
Niesen, O. B., '10.
*Nitze, H. B. C., '87.
Noerr, R. C., '97.
Nolan, J. J., '01.
Nostrand, B. B., jr., '78.
Nuncio, A. R., '84.
Nuñez, E. A., '09.

O

*deObaldia, J. A., '98.
Oberly, A. D., '89.
Oberly, F., '96.
Ochs, E. J., '09.
Ogden, R. L., '94.
O'Hearn, J. F., '94.
Ohlwiler, C. H., '05.
Okeson, W. R., '96.
Olmsted, C. L., '93.
Olney, L. A., '96.
*Olney, R. B., '92.
Olpp, A. E., '03.
O'Malley, J. M., '89.
O'Neill, C. J., '93.
Ordway, G., '94.
O'Reilly, J., '98.
Orth, C. L., '04.
Orth, H., jr., '92.
Ortner, L., '00.
Osborne, N. M., jr., '93.
Osbourne, A. S., '10.
Osbourne, R. B., '09.
Ozias, R. E., '92.

P

Packard, J. W., '84.
Packer, D. J., '04.
*Packer, H. E., '70.
Paddock, H. C., '98.
*Paddock, J. H., '79.
Page, S. E., '10.
Paget, A. M., '10.
Paine, P. M., '91.
*Palmer, H., '88.
Palmer, H. L., '96.
*Palmer, H. R., '99.
Paret, M. P., '78.
Parker, A. A., '10.
Parker, C. J., '88.
Parkhurst, C. W., '93.
Parshall, H. F., '08 (Hon.).
Parsons, A. R., '00.
Parsons, F. W., '02.
Patterson, D. W., '93.
Patterson, G. S., '83.
Pattison, E. L., '07.
Payne, F. J., '03.

Payne, W. A., '94.
Peale, R. R., '83.
Pearsall, C. B., '10.
Pearson, E. C., '03.
Peck, E. J., '01.
*Peck, H. R., '97.
Peck, J. G., '93.
Pecke, F. S., '75.
Peebles, C. R., '04.
Pelly, J. F., '04.
Pennington, J. H., '97.
*Pennypacker, N. R., '07.
Pentz, H. L., '05.
Perkins, W. C., '90.
Perley, F. A., '98.
Perley, F. G., '08.
Perry, R. S., '88.
Person, W. M., '05.
Peterman, W. C., '11.
Peters, F. C., '10.
Petersen, E. F., '08.
*Petersen, F. B., '85.
Petrikin, J. G., '96.
Pettinos, G. F., '87.
Pettit, J. R., '99.
Pettit, W. V., '94.
Petty, D. M., '09.
Pfahler, H. W., '04.
Phelps, E. V., '05.
Philips, J. H., '95.
Phillippi, W. H., '09.
Phillips, A. E., '90.
*Phillips, J., jr., '95.
Phillips, R. H., '87.
Pierce, H. S., '04.
Pierce, J. H., '10.
Pierle, C. A., '11.
Pile, F. W. B., '88.
Platt, C. W., '90.
Poffenberger, J. C., '11.
Polhemus, J. S., '72.
*Polk, R. K., '87.
Pollak, C. P., '87.
Pollitt, W. C., '04.
Pool, M. W., '96.
Poole, C. H., '10.
Pope, W., '08.
Porter, H. F. J., '78.
Porter, J. I., '07.
Porter, L. W., '09.
Porter, R. H. E., '89.
Porter, R. S., '07.
Porterfield, H. A., '83.
Potter, A., '90.
Potter, G. E., '80.
Potts, S. C., '94.
Poultney, J. L., '95.
Powell, J. H., '04.
Powell, N. S., '00.
Pratt, E. W., '90.
Pratt, M. D., '87.
Prechtl, H. J., '07.
Price, H. R., '70.
Price, J. B., '85.
Price, W. Z., '10.
Priestley, W. J., '08.
Prindle, E. J., '90.
Prizer, J. R., '08.
Protzeller, H. W., '05.
Purnell, F. H., '83.
Putnam, M. H., '97.
Pyne, F. R., '06.

Q

Quadenfield, W. A., '07.
Quarrier, C. W., '98.
Quier, E. A., '91.
Quigley, H. C., '95.
Quin, H. T., '11.

R

Raine, J. M., '08.
Rainey, L. T., '99.
Ramsay, A. C., '07.

Ramsey, H. E., '11.
Randolph, F. D., '92.
Randolph, R. B. F., '93.
Randolph, W. K., '78.
*Rankin, J. L., jr., '96.
Rasmers, F. E., '11.
Rathbun, R. S., '92.
Rau, A. G., '88.
Rauch, C. R., '77.
Rauch, C. W., '11.
Raymond, R. W., '06 (Hon.).
Raynor, C. E., '88.
Read, R. H., '78.
*Reamer, J. J., '00.
Records, V. C., '98.
Reed, H. B., '70.
*Reed, H. P., '96.
Reed, Percy Lawrence, '98.
Reed, Percy Leslie, '99.
Reel, G. K., '07.
*Rees, W. M., '74.
Reese, A. K., '89.
Reese, J. N., '00.
Reese, L. R. P., '11.
*Reeves, A. S., '84.
Rehfuss, L. A., '11.
Reichenbach, H. A., '09.
Reid, H. A., '96.
Reid, J. G., '93.
Reid, V. H., '99.
Reigart, J. R., '03.
Reimers, H., '11.
Reinecke, W., jr., '95.
Reinke, E. E., '08.
Reisler, E. T., '87.
Reist, H. G., '86.
Rench, R. B., '06.
Rench, W. F., '91.
Renner, R. R., '06.
Reno, H. P., '04.
Reno, J. W., '83.
Reussner, G. H., '11.
Reynolds, E. C., '93.
Reynolds, J. B., '07.
Reynolds, J. P., jr., '97.
Rhodes, C. H., '10.
Rhodes, S. A., '92.
Rice, W. P., '76.
Rich, E. L., '05.
Richards, F. E., '93.
Richards, G. T., '87.
Richards, H., '76.
Richards, J. W., '86.
Richards, L. W., '76.
Richards, R. H., '10.
Richards, W. P., '88.
*Richardson, G. M., '86.
Rick, A. H., '10.
Rickert, O., '88.
Rickert, R. E., '10.
*Ricksecker, E., '82.
Riddick, W. C., '90.
Ridgely, J. T., '09.
Riegel, B. D., '98.
Riegel, J. I., '92.
Riegel, J. S., '90.
Riegel, S. S., '97.
Rights, E. J., '95.
Rights, H. T., '95.
Riley, H. M., '10.
Rinehart, G. S., '11.
Ritchey, G. W., '93.
Riter, S. N., '95.
Ritter, L. E., '08.
Robbins, N. B., '03.
Robbins, W. J., '10.
Roberts, G. R., '08.
Roberts, W. F., '02.
Roberts, W. H., jr., '06.
Robinson, G. L., '03.
*Rock, M., '69.
Roderick, T. C., '94.
*Rodney, W. H., '01.
Roebling, F. W., jr., '01.

*Rogers, A. L., '89.
Rogers, C. L., '83.
Rogers, E. G., '10.
Rogers, J. D., '03.
Roller, F. W., '94.
*Ronaldson, C. E., '69.
*Ronaldson, W. D., '70.
Root, B. T., '06.
Roper, D'A. W., '98.
Roper, P. R., '07.
Rose, J. A., '11.
*Ross, A. S., '86.
Ross, E. E., '08.
Ross, J. G., '00.
Roulston, C. K., '07.
Roundey, E. P., '97.
*Rovelo, G., '99.
Rowan, J. S., '10.
Rowe, C. E., '00.
Rowe, J. T., '07.
Rowley, H. W., '85.
*Royce, C. W., '97.
*Ruddle, G. A., '86.
Ruddle, J., '83.
Ruddy, J. A., '05.
Ruff, J. D., '82.
Ruggles, C. L'H., '03.
Ruggles, G. H., '96.
Rutter, C. B., '94.
Rutter, C. C., '96.
Ryan, F. C., '05.
Ryan, J. C., '01.
Ryder, C. E., '05.

S

Sachs, D. M., jr., '02.
Saenz, C., '09.
Sage, F. B., '93.
Saldaña, M. T., '07.
Salisbury, S. H., jr., '06.
Saltzman, A. L., '97.
Sanborn, J. E., '90.
Sanchez, A., '00.
Sanchez, A. J., '01.
Sanchez, E., '09.
Sanchez, R. F., '98.
Sanders, C. F., '97.
Sanderson, J. M., '10.
Sanderson, W. D., '08.
Sandorf, J. C., '07.
Sargent, F. W., '79.
Sasscer, F. H., '10.
Satchell, E. T., '00.
Sattler, W. R., '88.
Sauber, C. B., '09.
Saucedo, V., '03.
*Saulsbury, M. L., '93.
Savidge, A. C., '01.
Sayford, F. M., '10.
Sayford, N. H., '08.
Sayre, F. M., '08.
Sayre, W. H., jr., '86.
Scarlett, J. R., '07.
Schaeffer, G. H., '05.
Schafer, N. W. H., jr., '08.
Schall, W. G., '11.
Schealer, S. R., '09.
Schenck, C. H., '10.
Schenck, R. B., '09.
Schloss, J. A., '93.
Schmertz, E. C., '09.
Schmid, F. R., '03.
Schmid, M. H., '07.
Schmidt, E. H., '05.
Schmitz, R., '91.
Schnabel, E. A., '91.
Schnabel, T. G., '07.
Schnabel, W. R., '05.
Schneider, A., '92.
Schneider, H., '94.
Schomberg, B. F., '94.
Schoonover, C. M., '06.
Schotte, A., '93.
Schroedl, O. H., '11.

Schulz, C. A., '10.
Schwartz, C. W., jr., '89.
Schwarze, C. T., '05.
Schwarzwaelder, C. A., '11.
Schwecke, H. C., '98.
de Schweinitz, A., '05.
Schweitzer, E., '07.
Schwenk, W. H., '09.
*Schwinghammer, E., '95.
Scott, C. F., '97.
Scott, J. D., '07.
Scovil, H. H., '00.
Scudder, H. D., '72.
Scudder, W. M., '73.
*Scull, J. W., '87.
Seabrook, H. H., '97.
Seacrest, J. A., '05.
Searle, B., '84.
Seipt, H. S., '05.
Seltzer, H. K., '95.
Semper, W. F., '93.
Semple, J. B., '92.
Semple, L. B., '84.
Senior, S. P., '97.
Serfass, R. B., '09.
Serrell, A. H., '97.
Sesser, J. C., '96.
Seyfert, J. C., '96.
Seyfert, S. S., '04.
Shaeffer, J. W., '01.
Shaffer, C. A., '05.
Shaffer, E. F., jr., '07.
Shaffer, S., '10.
Shaffner, C. N., '10.
Shank, C. U., '09.
*Shapleigh, W., '71.
Sharp, A. B., '93.
Shaw, A. R., '11.
Shaw, J. G., '09.
Sheaffer, F. B., '97.
Shelby, C. K., '92.
Shellenberger, L. R., '91.
Shema, J., '05.
Shenberger, G. H., '05.
*Shepherd, A. Y., '96.
Shepherd, G. E., '94.
Shepp, D. F. B., '98.
Sheppard, J. L., jr., '97.
Sherman, H. J., '90.
Shero, J. E., '95.
Shimer, A. A., '99.
Shimer, E. B., '10.
*Shimer, I. A., '91.
Shimer, R. H., '08.
*Shipley, C. E., '94.
Shipman, E. H., '88.
Shive, S. S., '04.
Shively, W. R., '04.
Shoemaker, C., '10.
Shoemaker, W. C., '90.
*Shorkley, C. C., '08.
Showalter, D. N., '06.
Showalter, L. D., '96.
Shriver, H., jr., '96.
Shriver, J. C., '92.
Shultz, J. J., '09.
Shultz, J. S., '00.
Shuman, E. P., '97.
*Sickler, S. B., '82.
Siebert, J. S., '86.
Siegel, R. S., '95.
Sigison, E. H., '95.
Simons, J. A., '02.
Singer, M. W., '06.
Sinn, F. P., '04.
Sisson, G. A., '05.
Skidgell, F. M., '10.
Skillman, R. N., '03.
Slack, J. B., '95.
Slade, J. E., '97.
Slate, J. H., '11.
Slifer, W. P., '02.
Slifer, W. S., '04.
Small, A. G., '09.

Smartt, G. M., '08.
Smith, Alfred P., '05.
Smith, A. Parker, '84.
Smith, D., '03.
Smith, D. R., '03.
Smith, E. C., '10.
*Smith, E. O., '85.
Smith, F. B., '97.
Smith, F. S., '87.
Smith, H. D., '08.
Smith, H. P., '10.
Smith, J. A., '06.
Smith, J. H., jr., '11.
Smith, M. L., '07
Smith, M. L. H., '07.
Smith, N. G., '06.
Smith, N. W., '93.
Smith, O. H., '11.
Smith, P. H., '02.
Smith, P. H. W., '92.
Smith, R. E., '94.
*Smith, R. H., '05.
Smith, S. G., '07.
Smith, T. K., '03.
Smith, W. C., '06.
Smith, W. E., '10.
Smith, W. S., '00.
Smoot, B. R., '98.
Smull, J. G., '06.
Smyth, A. M., '89.
Snyder, C. S., '00.
Snyder, E. E., '87.
Snyder, F. B., '05.
*Snyder, J. C., '04.
Snyder, N. H., '05.
Snyder, P. R., '11.
Snyder, T. A., '08.
Sohon, M. D., '90.
Soleliac, E. A., '93.
Solorzano, A., '00.
Sommers, W. J., '09.
Sosnowski, J. A., '11.
Spaeth, A. J., '08.
Spalding, F. P., '80.
Sparks, E. E., '09 (Hon.).
Spear, M. E., '06.
Speirs, G. D., '09.
Speirs, W. H., '99.
Spengler, J. H., '86.
Spilsbury, P. G., '05.
Spinosa, A. V., '03.
Sprague, H. W., '97.
Spratley, G. L., '07.
Spry, E. M., '09.
Staab, W. A., '10.
Stack, M. T., '97.
Stackhouse, E. S., '86.
Stair, J., jr., '11.
Stamilman, L. M., '08.
Standing, A. J., '11.
Starkey, L. C., '98.
Starkey, W. P., '00.
Startsman, C. W., '01.
Stauffer, H. S., '01.
*Stauffer, J. W., '98.
Stearns, H. T., '05.
Steckel, A. P., '99.
Steele, H. E., '07.
Steinmetz, E. G., '95.
Stem, S. G., '08.
Stephens, H. O., '08.
Stern, G., '93.
Sterner, A. R., '97.
Sterner, E. J., '09.
Stevens, E. S., '02.
Stevens, T., '86.
*Stevenson, W. Alonzo, '88.
Stevenson, W. Alston, '90.
Stewart, J., jr., '97.
Stewart, M., '84.
Stillwell, L. B., '07 (Hon.).
Stilson, H. T., '91.
Stinemetz, W. R., '93.
Stinson, C. H., '83.

*Stinson, R., '83.
Stobaeus, W. C., '10.
Stocker, H. R., '06.
Stocker, J. E., '95.
Stockett, A. W., '89.
Stockett, M. S., '98.
Stockton, L., '81.
Stockton, R., '10.
Stoddard, J. C., '09.
Stoek, H. H., '87.
Stokes, W., '88.
Story, P. B., '08.
Stouffer, C. S., '06.
Stout, H. E., '86.
Stout, R. P., '91.
*Stratford, H. R., '94.
Straub, P. B., '97.
Straub, R. M., '99.
Straub, T. A., '90.
Strauch, R. D., '10.
*Strauss, J. A., '00.
Street, G. L., jr., '06.
Struble, L. P., '09.
Stubbs, H. R., '10.
Stull, G. R., '03.
Sturges, W. E., jr., '10.
Sturgis, L. R., '10.
Sullivan, J. J., '10.
Sullivan, L. N., '05.
*Surls, J. K., '86.
Swartz, W. C., '94.
Swope, B. M., '07.
Swope, R. B., '10.
Sykes, F. G., '94.
Symington, E. H., '98.
Symington, J. F., '01.
Symington, T. H., '93.

T

Talley, R. L., '04.
Talmage, J. E., '91.
Tarleton, R. M., '95.
Tattershall, E. R., '06.
Taylor, C. L., '76.
Taylor, E. S., '96.
Taylor, J., '93.
Taylor, L. C., '89.
Taylor, R. F., '02.
Taylor, R. S., '95.
Taylor, W. B., '96.
Taylor, W. P., '86.
*Terrell, O. O., '87.
Thayer, H. R., '06.
Thomas, C. C., '08.
Thomas, L., '07.
*Thomas, T. C., '97.
Thomas, W. A., '07.
Thomas, W. E., '02.
*Thome, J. M., '70.
Thompson, C. H., '94.
Thompson, R. R., '05.
Thomson, F. duP., '90.
Thomson, J. A., '96.
Thornburg, C. C., '11.
Thornburg, C. G., '09.
Thornton, E. T., '01.
Thoroughgood, R. W., '02.
Throop, A. T., '89.
Throp, R. R., '05.
Thurlow, N., '95.
Thurston, E. C., '96.
Thurston, J. W., '96.
Tilghman, S. H., '07.
Tobelmann, H. A., '00.
Todd, J. T., '06.
Tolman, C. M., '85.
Tompkinson, C. C., '90.
Toohy, J. M., '10.
Tooker, E. P., '07.
Topping, W. S., '91.
Torrey, R. H., '09.
Toulmin, H., '86.

Toulmin, P., '86.
Townsend, C. F., '95.
Townsend, J. B., '95.
Toy, F. L., '09.
Traeger, J. H., '03.
Trafton, C. E., '96.
Travis, G. W. L., '07.
Treat, L. B., '10.
*Treharn, L. B., '80.
Treichler, W., '97.
Treverton, E. R., '07.
Tripp, H. C., '96.
Tripp, H. I., '10.
Trotter, F. F., jr., '11.
Trout, P. H., jr., '94.
Troutman, F. E., '08.
Troutman, G. P., '10.
Troutman, L. E., '93.
Trueworthy, O. W., '94.
Trumbower, H. R., '03.
Tucker, R. H., '79.
Tunstall, A. L., '08.
Tunstall, W. P., '03.
Turner, Charles P., '89.
Turner, Clarence P., '94.
Turner, Claude A. P., '90.
Turner, R. F., '09.

U

Ulman, M. H., '07.
Ulrich, W. F., '99.
Umble, C. J., '09.
Underhill, G. G., '01.
Underwood, C. N., '06.
Underwood, C. W., '94.
Underwood, J. W., '04.
Underwood, W. E., '97.
Usina, D. A., '91.
Usina, M. N., '92.
Utley, J. C., '07.

V

Valk, E. E., '06.
Van Alen, J. S., '01.
Van Blarcom, W. C., '10.
Van Cleve, A. H., '90.
van den Bergh, J. F. Van B., '95.
Vander Horst, E., '91.
Van Duyne, H. R., '97.
Van Duyne, J. R., '00.
Van Duyne, P. R., '06.
Van Kirk, B. R., '80.
Van Kirk, E. P., '87.
Van Liew, W. R., '95.
van Reenen, R. J., '06.
*Vansant, C. H., '95.
Van Sickle, B. B., '03.
Van Vleck, A. N., '08.
Veeder, C. H., '86.
Vela, J. I., '11.
Vicente, M. L., '11.
Viehle, J. S., '99.
Villalon, J. R., '90.
Vockrodt, F. A., '06.
Vogt, C. H., '09.
von Borries, W. J., '05.
von Maur, J. D., '94.
Vossberg, R. W., '07.

W

Waddill, J. T., '07.
*Wagner, J. R., '85.
Wagoner, C. P., '97.
Wahl, R. A., '10.
Wahle, R., '04.
Wait, J. R., '06.
Walker, C., '89.
Walker, H. S., '05.
Walker, J. H., '05.
Walker, L. A., '08.
Walker, L. W., '92.

Walker, M. A., '03.
Walker, R. W., '84.
*Wallace, J. H., '06.
Wallace, J. S., '96.
Walters, C. C., '11.
Walters, H. R., '03.
Walters, R. W., '07.
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